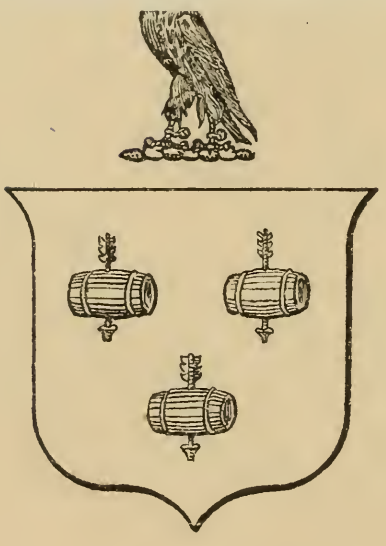

Henry Carrington Bolton

H. Carrington Bolton. Ph.D.

With the sincere regards of.

Henry Norton.

President HENRY MORTON, Ph. D.

Portrait presented to the Trustees and Faculty, by the Alumni Association of the Stevens Institute of Technology, February 15, 1892.

BIOGRAPHICAL NOTICE

OF

PRES'T HENRY MORTON, PH. D.

OF THE

STEVENS INSTITUTE OF TECHNOLOGY.

PREPARED BY

PROF. COLEMAN SELLERS, E. D.,

AND

PROF. ALBERT R. LEEDS, PH. D.,

ON THE OCCASION OF THE PRESENTATION TO THE TRUSTEES AND FACULTY, BY THE ALUMNI ASSOCIATION, OF A PORTRAIT OF PRESIDENT MORTON,

FEBRUARY 15, 1892.

THE ENGINEERING PRESS,
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PREFACE.

THE present volume seeks, in a modest way, a wider expression for that appreciation which broadens with the understanding and deepens with the course of time. Like other truths, a true appreciation seeks to link itself to the future and perpetuate through time the merits of worth.

The suggestion that the Alumni of Stevens present to their Alma Mater a portrait of President Morton, in token of their esteem and appreciation of his many labors, met with the most hearty and ready response. The Committee who undertook the arrangement and execution of the suggestion found themselves enabled, through the liberality of the Alumni and the proffered aid of Professors Coleman Sellers and A. R. Leeds, to issue the following biographical sketch as a souvenir of the presentation. At the mid-winter meeting of the Alumni Association, held February 15, 1892, the portrait of President Morton was presented to the Trustees and Faculty of the Stevens Institute of Technology. Mr. E. B. Wall, the President of the Association, delivered the address of presentation, to which Professor Coleman Sellers responded, paying graceful tribute to President Morton, his valuable work and their long and unvaried friendship.

A reproduction of the portrait is shown in the frontispiece ; it is a photo-engraving made directly from the original, which is a painting of half life-size, by Mr. A. D. Turner, of New York, an Artist selected by President Morton. It represents its subject in a familiar attitude and place, and may be well called a speaking likeness.

The surroundings are appropriate and suggestive. To the right is seen the blackboard, on which so many diagrams have been sketched to aid in explanations ; to the left on the table stands the spectroscope with which were made the researches on the Fluorescent and Absorption Spectra of the Uranium salts, elsewhere referred to, and also the Induction Coil, used in other researches and for so many brilliant lecture illustrations.

Below the table is the College Lantern, arranged by President Morton and for some time manufactured under his direct management. To the right and in the rear are seen the modification of Gassiott's "Electric Star" and a Geissler tube of unusual dimensions, which also figured conspicuously at some of President Morton's public and class lectures, and behind the figure is the curtained window through which a porte-lumière transmitted sunlight for his spectroscopic researches, and occasionally for lecture illustrations.

In preparing the present volume the Committee have gladly availed themselves of a number of plates which were placed at their disposal by President Morton, who has for some time been having such pictures prepared and reproduced as "half tone" plates, with a view to some future publication.

ALFRED P. TRAUTWEIN, M. E., '76.
WM. HEWITT, M. E., '74.
ALFRED R. WOLFF, M. E., '76.
GEO. M. BOND, M. E., '80.
MAUNSEL WHITE, M. E., '79.
C. J. FIELD, M. E., '86.
ALEX. C. HUMPHREYS, M. E., '81.

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BIOGRAPHICAL NOTICE OF
PRESIDENT HENRY MORTON, PH. D.

IN the opening paragraph of the biography of Sir Humphrey Davy, his brother, Dr. John Davy, remarks that the most important part of the history of a man of science is necessarily recorded in his works. While this remark is eminently just, and a considerable part of these brief memoirs of the life of President Morton must necessarily be devoted to the giving of some account of his numerous and varied works of science proper, yet, at the same time, the especial interests which occupy our minds and hearts with delightful reminiscences at the present hour, require the consideration of many other works that in this connection are of no less value and importance. Not alone in pure science, but in science applied to the pressing needs of the present generation, and in science applied and incorporated as part and parcel, as web and woof, so to speak, of the substance and texture of a new species of education for young men, are his claims recorded to lasting remembrance and gratitude.

President Henry Morton was born in the City of New York, on the 11th of December, 1836. His great-grandfather,

John Morton, came to New York in the Commissary department of the British Army prior to 1761, in which year he married a Miss Kemper, and soon after relinquished his position in the service and engaged in business, in which he soon acquired a large property.

At the outbreak of the Revolution he owned and occupied a large brick house on Water Street, with a wharf and warehouses in the rear, at which his ships unloaded; his business consisting in trade in flax, flax-seed and linens between Ireland and this country.

At the commencement of the dispute between England and the Colonies, John Morton took the side of liberty, and when the occupation of New York by British troops was imminent, he converted as much of his property as possible into cash, which he deposited in the Loan Office (a sort of National Bank established by the United Colonies).

The amount thus devoted to the use of the new Government, won for him among the British the name of the "Rebel Banker."

He removed his family and transportable effects to Basking Ridge, N. J., near Morristown, where his house afforded a hospitable refuge to officers and soldiers of the Continental Army throughout the war. He died at that place before the evacuation of New York in 1783.

After this time, his family returned to their house in New York, where his eldest son, General Jacob Morton, who had studied law with Judge Patterson at Raritan, practised his profession for about fifty years.

He also held a commission in the State Militia; was Clerk of the City Council for twenty-five years, and held at various times the offices of District Attorney, Alderman and Member of the State Legislature. He served as aid-marshal at the inauguration of Washington (1789) and was intimate with him, with Lafayette and with all the distinguished men of that time.

Indeed, on all public occasions his house on the Battery was a centre of festivities, and no one of prominence visited New York without sharing his hospitalities. He died in 1836, leaving seven sons and one daughter.

The youngest of these sons, Henry J. Morton, was educated at Columbia College and the Theological Seminary, and in the year 1830 was ordained to the ministry of the Episcopal Church.

In the same year he entered upon the duties of his profession as Rector of St. James Church, Philadelphia, and remained at that post for fifty-six years until his resignation in 1886, on account of failing sight and strength. He died November 1st, 1890.

As a young man he exhibited a remarkable talent in drawing and painting, and was the only member not a professional artist of the "Sketch Club," out of which developed the present "Century Club" and "Academy of Fine Arts." Though he never made fine art a subject of study, he continued throughout life to exercise this talent as a recreation and for the pleasure of his friends, and has left hundreds of sketches and paintings which would do credit to any professional artist. The plate facing this page is a reproduction of one of Dr. Morton's pencil designs.

This brings us again to the subject of these notes, who is the son of the Rev. H. J. Morton, D. D., and in whom, it will appear, various hereditary traits developed, which make the foregoing memoranda specially interesting.

At the age of seventeen, Mr. Henry Morton entered as Sophomore the University of Pennsylvania, graduating three years later in the class of 1857. During his college career he entered with keen interest into the literary and scientific diversions of the University, and found time also to sketch and paint in crayon and water colors. This latter diversion proved later on to be much more than a mere amusement, as will appear presently. The College Philosophical Society, of which he was a member, called the Philomathean, determined upon the adoption of a new badge and selected, from a number

Re-production of pencil sketch design, drawn by Rev. H. J. Morton in 1829.

of designs submitted, one made by Mr. Morton, which is still used by the Society and appears on the decorations of its meeting rooms and upon its publications.

In 1856 there was presented to the same Society a plaster cast from an engraved stone tablet, discovered in Egypt (during the occupation of that country by the French under Napoleon) near the town of Rosetta in the Delta, and named from that place "the Rosetta Stone."

It contained inscriptions in three texts: Greek, Demotic and Hieroglyphic, and was greatly valued as a probable key to the interpretation of the last named characters, with which the monuments of ancient Egypt are covered.

It had already been studied by the great English scientist, Dr. Young, and by Champollion, the father of Hieroglyphic science, and by some others, but no thorough and complete translation of all its texts had ever been made.

Such being the state of affairs, a motion was offered, it must be admitted in a spirit of levity rather than with serious intent, by Mr. Morton, to the effect "that a committee be appointed to translate the inscriptions on the Rosetta Stone, and present the translation to the Society at a future meeting."

This motion having been carried, its proposer, with two colleagues, Messrs. Chas. R. Hale and S. H. Jones, was appointed to execute it.

By one of those accidents which often decide important matters, at about the same time Mr. Morton's interest was excited in the subject of Hieroglyphic interpretation by reading a lecture on that subject, which had been delivered by the famous English Cardinal, Wiseman, at Rome, and this interest led him to follow up the matter of the Committee and turn a jest into earnest, by devoting a large part of his spare time during his Junior and Senior years at the University, to the general study of Egyptian Hieroglyphics and to the special translation of the corresponding text on the Rosetta Stone. One of his colleagues, Mr. C. R. Hale (now Dean of Davenport, Iowa), at the same time worked out translations of the Greek and Demotic texts. When all was completed, Mr. Morton took the manuscript with him during his summer holiday in the country, and illuminated each page with an appropriate design in colors.

The rather remarkable manuscript thus produced was duly presented to the Society and attracted considerable notice, especially from the Hon. Henry D. Gilpin, a classical scholar of high attainments, who had held the office of U. S. Attorney-General, and who was emphatic in the opinion that this work should be reproduced in some adequate way. After much investigation it was found that the only feasible plan was to lithograph the entire work, and this could only be

done within reasonable limits of cost, if Mr. Morton would undertake the drawing on stone of all his designs.

He had no experience whatever in drawing on stone, but with the daring of youth and inexperience, he readily undertook this labor, and commencing work in July, 1858, by Christmas of the same year had completed a book of 172 pages, with upwards of 100 original designs and illustrations in color.

The pages containing the minute (letter by letter) explanation of the Hieroglyphic text, and some others, did not have marginal space enough to admit of "illumination."

Although the principal publishers of the country, to whom an opportunity to "handle" this work had been offered, declined with unanimity, it met with such popular favor, that, within two weeks of its issue the entire edition was exhausted, and it has since been numbered among the "rare" or "scarce" books occasionally offered for sale when some great library is distributed.

In a letter addressed by the famous Baron Alexander Von Humboldt to one of the Committee, this great scholar says :

"The scientific analysis of the celebrated inscription of "Rosetta, which, despite the confusion of the Hieroglyphic "style, remains an historical monument of great importance, "has appeared to me especially worthy of praise, since it

"offers the first essay at independent investigation offered by "the literature of the New Continent. It is for this national "relation that I especially greet this independent work. "Little versed myself in this class of studies, I ought, however, "to greet the so conscientious work of the learned Committee "of the Philomathean Society, since the results now obtained "contribute to prove the justice of the system of Champollion, "to which my brother, William Von Humboldt, was the first "to render justice in Germany.

"The picturesque ornaments added by Mr. Henry "Morton add to the interest inspired by a work well worthy "to be widely spread in your learned and free country."

It may be of interest to mention that the original Rosetta Stone is a slab of black sienitic basalt, 3 feet 1 inch high, 2 feet 5 inches wide, and of irregular thickness of from 6 to 12 inches. Its level and polished face, 3 feet 1 inch by 2 feet 5 inches, has on it 14 lines of Hieroglyphic, 32 lines of Demotic and 54 lines of Greek writing. These texts alone, if simply transcribed, would fill many pages of an ordinary book.

The Hieroglyphic text, with its detailed explanation, occupies 41 pages of the printed report, which is a square octavo 7½ by 8½ inches.

As this Rosetta Stone Report is now a very rare work and not easily accessible, reproductions in black and white

Reduced copy of page 66 of the "Rosetta Stone Report," being part of the explanation of the method of Hieroglyphic interpretation.

from a couple of its pages have been made and will be found facing pages 14 and 16. In order to adapt them to an ordinary book page they have been reduced about 2¼ inches in height and 1¼ inches in width.

Though Mr. Morton did not pursue his linguistic studies for any serious purpose in after life, he made occasional use of his classical knowledge in some humorous publications, such as an essay on the Antiquities of Bloomerism, full of quotations from Sophocles, Herodotus, Diodorus Siculus, Apollonius Rhodius, and Strabo, and a collection of humorous passages in prose and verse, including many gems from the Greek and Latin Anthology, entitled, "The Misogonist's Dinner."

In the interval, however, between the inception of this work and its final publication in 1859, had occurred Mr. Morton's graduation, the valedictory being delivered by him in verse, and also his entrance as a student into the law office of Mr. George M. Wharton, a well-known and successful advocate at the Philadelphia bar.

But it was not in the profession of law, though his legal studies bore their fruit, in many cases, of very difficult and involved expert testimony in later life, that President Morton's sphere of labor was destined to be found, and in the year 1859 he relinquished it and devoted himself entirely to the study

of chemistry and physics, which he had pursued as amusements, together with carpentry and like mechanical work, since childhood. As in the lives of many other men of versatile ability, however, an apparent accident was the occasion of his entrance, after his previous essays, successful though they had been in the direction of law, art and literature, into his future career of rapidly widening fame and usefulness.

It happened that the date referred to marked the beginning of a reaction in school and college, against the almost exclusive attention hitherto paid to Latin, Greek and kindred linguistic studies, and in favor of the recognition of the growing claims of Natural Science to a proper place in the curriculum. The Trustees of the Episcopal Academy of Philadelphia, one of the fitting-schools of the University, were solicitous to take part in this progressive movement but for a time were unsuccessful in finding an instructor capable of arousing an interest and holding the attention of the pupils. Always ready to enlist in undertakings looking to the diffusion of useful knowledge, Mr. Wharton's law student volunteered to devote his leisure hours to giving some lectures on chemistry and physics that would be palatable and interesting to boys. A little room was fitted up in the Academy for his use, and a lecture table with pneumatic trough and

Reduced copy of page 71 of the Rosetta Stone Report, being the title page of the letter-by-letter translation of the Hieroglyphic text.

other appliances, largely the work of his own hands, was speedily improvised. But a result quite unlooked for by the Trustees soon followed. The boys found the novel and brilliant experiments, the clear and entertaining explanations of the facts and phenomena of every-day life and experience, so much more interesting than the derivation of a Greek root or the history of Remus and Romulus, that the little room in the course of a few weeks became all too small for those who wanted to come in. The Trustees and the outside public also wanted to hear, and to accommodate them the Academy was enlarged in the following spring by the building of a wing with a large and admirably equipped lecture-room, devoted to the uses in lecture and research of Professor Morton, as the incumbent of a chair instituted expressly for him to fill.

The new lecture-room speedily became famous, and in the afternoons, at extra lectures, was crowded with pupils from other city academies, and in the evening with older listeners who were glad to spend a delightful hour in hearing striking expositions of the novel discoveries in physical science. Engagements and professorships, much too numerous to fill, were offered to the lecturer. In the year 1863, he was elected Professor of Chemistry in the Philadelphia Dental College, and the year following was appointed Resident Secretary of the Franklin Institute of Pennsylvania.

This latter appointment grew out of a growing appreciation in the minds of scientists, engineers and manufacturers in Philadelphia (distinguished representatives of which classes in the community were to be found in the governing body of the Institute), of certain rare qualities of urbanity, tact and judgment exhibited by Professor Morton, and all of which qualities were now greatly needed in a new and critical period in the history of that institution. It had been originally founded to foster the growth of the Mechanic Arts in the State of Pennsylvania, but after many years of active usefulness had at the date referred to lapsed into a decrepit state; running in time-worn ruts, its library antiquated and little used, its lectures and weekly meetings sparsely attended. The winter following his appointment audiences thronged the freshly-equipped and decorated lecture-room, and the meetings were the occasion of interesting reports and discussions.

In order to augment the usefulness and pecuniary resources of the Franklin Institute, and strengthened by the cordial assistance of its officers, Professor Morton delivered, at the Academy of Music in Philadelphia in the month of April, 1865, the first of a series of lectures on Light, Sound and cognate topics, of which sixteen others were given in the same great auditorium during the course of the six following years. The history of these lectures is so well told in the

address made by Professor Coleman Sellers, E. D., on the occasion of the presentation of the portrait of President Morton (which led to the preparation of the present biographical sketch), that we cannot do better than quote it in this place.

"At one of the first meetings of the Managers of the Franklin Institute after Mr. Morton's appointment, it was suggested that an excellent means of interesting the public at large in the objects of the Institute would be a course of scientific lectures, delivered in some large hall.

"One of the Managers was even so bold as to suggest the Opera House or Academy of Music, one of the largest auditoriums in the country, seating over 3,500 persons. Others considered this too venturesome, but it was finally decided to leave this to Mr. Morton's decision.

"Deputed to communicate with Mr. Morton on this subject, I well remember the characteristic courage and enthusiasm with which he at once seized on the idea of making the so-far unparalleled experiment of devising and executing illustrations on such a scale as should render them impressive on so large a stage and to so vast an audience.

"All who came in contact with him were inspired with his confidence and enthusiasm (myself among the number), and the preparations were commenced at once.

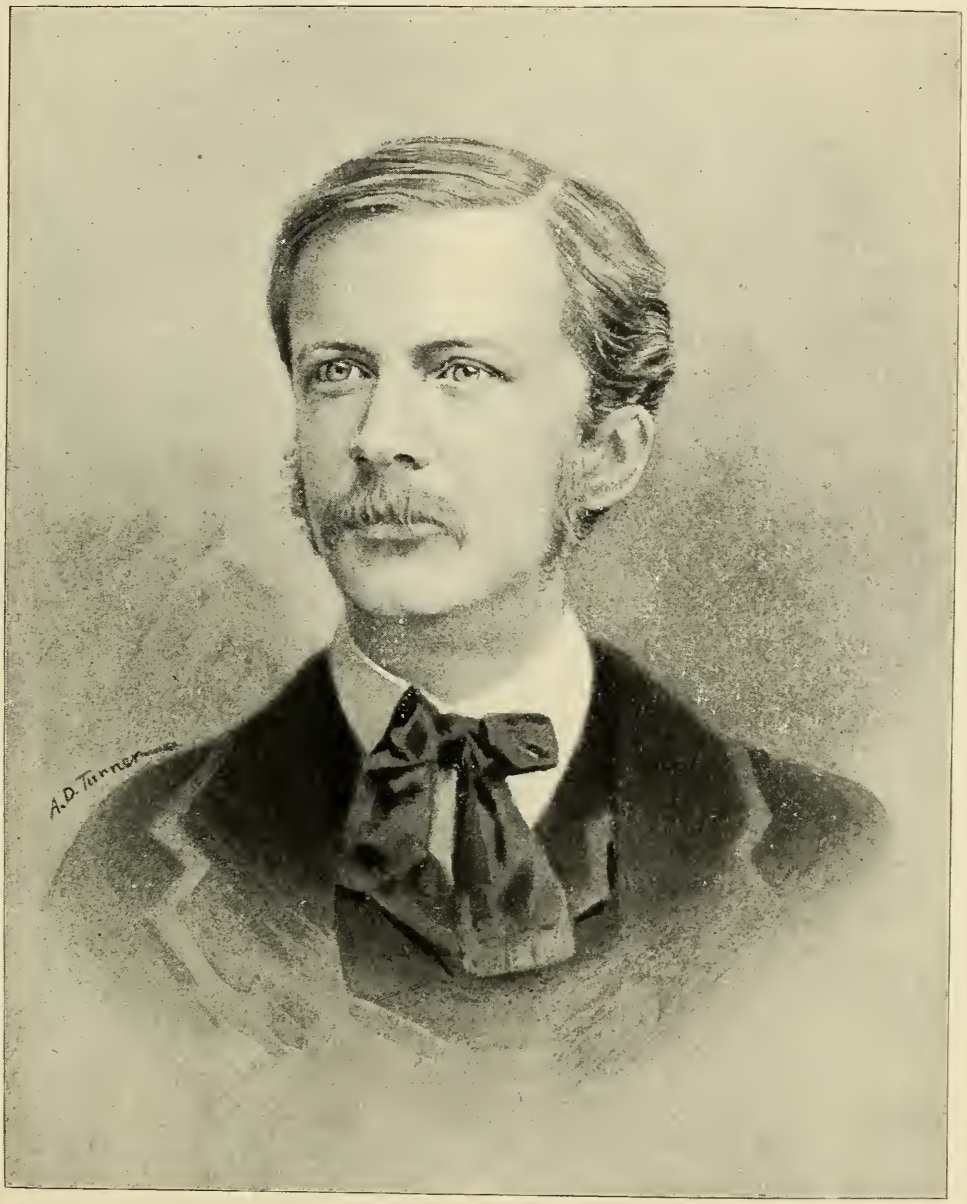
"Some notices of these got abroad, and long before the date assigned for the lecture, every seat in the house was sold and so pressing was the demand, that the Academy was engaged for another evening, a few days later, and, before the night of the first delivery arrived, every seat had been again sold for the repetition.

"There are occasions, even in the life of a scientific professor, which call for no small stock of moral courage, and the evening in which Mr. Morton for the first time walked forward upon a public stage in the face of an audience which crowded every seat and every inch of standing room, with the consciousness that he was committed to the absolute necessity of a success by the arrangements for the repetition, was one of them.

"I was with him at the time, having undertaken the office of manager, to direct and superintend the work of his assistants behind the screen; and I have not forgotten what were my own feelings.

"But when the curtain rose, he stepped forward with easy grace, amid the enthusiastic applause which greeted his appearance, and began his lecture as calmly and collectedly as if he had done the same thing fifty times before.

"He told me afterwards that he was so anxious about the success of his experiments, that he had no room in his



Portrait of Professor Henry Morton.

By A. D. Turner, from photograph taken in 1865.

mind for personal embarrassment, or the nervous agitation often caused by facing a great audience.

"I need hardly say that the lecture throughout was a success. The clearness of the explanations and the novelty and beauty of the experiments held the audience in close attention for nearly two hours, and when Mr. Morton made his exit from the stage, amid applause even heartier than that which had welcomed him, he carried with him a reputation as a scientific lecturer which, I believe, has never been equalled.

"During the following years similar lectures on related subjects were given by Mr. Morton in the same place. Some of their titles were the following: 'Reflection,' 'Refraction,' 'Sunlight,' 'Moonlight,' 'Eclipses,' 'Fluorescence,' and so on.

"In these lectures Mr. Morton used not only numberless new devices for the production of striking illustrations of scientific phenomena, but also brought into play the appliances of the stage, such as shifting scenery to aid in color effects, stage traps to bring apparatus into position when wanted, and endless other applications.

"In looking over some old papers a few days since, I came across some interesting relics pertaining to these lectures in the shape of notes in Mr. Morton's writing, which were for my use as 'stage directions' in the management of his

assistants and in securing the prompt and orderly succession of the experiments.

"They form curious reading and well illustrate how complex were the combinations and how necessary were complete organization and co-ordinate action to the successful presentation of these experiments. One of these memoranda reads as follows:

"'Then when through McIntyre will show diagram 6, Mr. Brown, Mr. Higby, etc., will then remove truck and lantern, while Mr. Sellers removes electric lamp to table and makes connections ready. Then Mr. Higby will RUN IN THE ANGEL, Mr. Sellers will light up electric lamp, Mr. Brown will light a red fire, and Mr. Stewart a piece of magnesium as also Klapp, Phillips, etc.

"'Then Mr. Higby will RUN OUT THE ANGEL and McIntyre will show diagrams 7 and 8, while Mr. Sellers removes the electric lamp and gets ready red and green fires.

"'Show shadow of veil and needle. Send out lantern by Klapp and Phillips.

"'Higby will then RUN IN EARTH AND WORK MOON, then run off these and bring in movable flat.

"'Mr. Higby will then RUN IN MOUNTAINS on background and bank in front while Mr. S. SETS THE SUN ON FLOOR IN POSITION FOR RISING. Show Spectre of Brocken. During this

time Mr. S. will arrange the other electric lamp BEHIND THE MOUNTAINS for next experiment.

"'Mr. Outerbridge will tell Mr. Higby to lower white curtain, raise horizon drop and RUN OUT MOUNTAINS, and McIntyre to show diagrams 3 and 4.

"'Experiments with electric light in the sun. Mr. S. on signal from Outerbridge will light up and have Combat of giant and dwarf. Klapp and Outerbridge. Rabbit on chair. CARRY OFF MEN IN HAND, run about and STEP INTO CEILING, etc., etc., etc.'

"I also find among my notes the perorations or concluding paragraphs of two of Mr. Morton's lectures, which are interesting as illustrating the poetical forms of expression which, judiciously introduced, added not a little to the charm of these discourses. The first was the conclusion to the lecture on 'Light,' in which the analogies, or rather close relations, between Sound and Light, had been dwelt upon and fully developed. It reads as follows:

"'From what has been seen this evening I hope that you will be able to attach a more definite meaning to that frequently used, though vague expression, 'Music of the Spheres'.

"'There is such music. All day long from the glowing sun pours down an harmonious flood of commingled 'light'

notes, which are echoed, reflected and reverberated in a thousand accordant tones, from various natural objects. Then, when night comes upon the earth, the stars and planets from their far-off seats above the clouds, send down songs, fainter but not less sweet, like the voices of birds, singing as they float and circle amid the sky. And always and in all places amid the nearer planets, and amid the more distant stars, and throughout the vast abyss of the Universe, floats everywhere, floats eternally, that commingled symphony of luminous vibration, which constitutes the grand visible anthem of nature, the true 'Music of the Spheres'.

"The other passage was the conclusion of a lecture on Color, in which the composition of sunlight and the characteristics of light from colored stars had been, among other things, fully explained. It runs as follows:

"'As a merely poetical, and not very strict analogy, we may regard this experiment as a spinning of colored light threads into a single white cord. From the lantern to the screen, run at first the seven colored threads, distinct and distinguishable at every point—then we give motion to the painted glass, and twist these seven bands into a single compound fillet of white light. Carrying out this idea into our contemplation of the astronomical universe it naturally develops itself into a very beautiful thought.'

"'We seem to see the countless stars, each throwing out a web of light rays; some, like our sun, of woven white, others of every rainbow dye. Through this vast variegated web flash constantly the golden shuttles of the comets, weaving together, into compact perfection, the great and glorious Universe, the 'garment of God'."

As lectures, such as were delivered by Professor Morton at the Academy of Music, have never been repeated since he retired from that field, it would seem worth while, in this place, to make some record of their characteristic features, which we will do by quoting from a few notices which appeared in the contemporary press.

We should, in the first place, premise that the prime object of these lectures was to attract and interest the general public in scientific subjects, and that, with this object in view, Professor Morton made it his aim to develop experimental illustrations of the most striking and scenic character, utilizing for this purpose all the appliances of the scenery and stage mechanism which were at his command in such a place as the Academy or Opera House, and adding many devices of his own, especially constructed for the object in view. This being explained, the reports referred to will speak for themselves.

Preliminary notice of First Lecture at the Academy of Music. Report from "The Press," Philadelphia, Wednesday, April 26, 1865.

"IN-DOOR RAINBOWS."

"We were invited lately to attend some experiments with lime lights, and galvanic batteries producing the electric light, and were so much surprised and interested by the exhibition that we venture to give a brief history of our experience during the evening:

"The experiments were made at the laboratory of the Episcopal Academy, 1314 Locust Street, by Mr. Morton, Lecturer on Natural Philosophy in that institution, who is, we hear, Professor of Chemistry in the Philadelphia Dental College, and also Secretary of the Franklin Institute. There was a goodly array of professional men assembled, and the lecturer proceeded to give a brief, but very clear and striking exposition of the theories of Light. He then proceeded to illustrate his various propositions with experiments of such singularity and beauty that we were quite taken by surprise.

"The first exhibition was of the heating effect of the galvanic current when applied to a wire several feet in length, suspended between two upright metallic columns. In an

instant the arching wire blazed forth with brilliancy quite dazzling, and reminded one of Mahomet's bridge cast over the profound abysm of the nether world. The bridge burned like the bush of Moses, but, like it, was not consumed. The wire sufficed to conduct the current without being melted or dissipated.

"The galvanic current was then caused to pass (by wires previously laid) to the rear of the room, where was arranged a large lantern, in the focus of whose lens the electric fluid was caused to pass between two carbon points, the image of these points and of the electric fire being projected on a vast screen at the opposite extremity of the audience chamber. The effect was magical. Two huge cones, like those of Ætna and Vesuvius, were seen approaching each other, blazing with intense light and heat. As they threatened each other in this antagonism, sheet-lightning seemed to play over their brilliant cones, throbbing and pulsating as when on summer nights the distant horizon flickers with the flash of storms too remote to send to us the sound of their tumult. Gradually these cones would melt away, and then suddenly rush together with a clash and renewed fury of fire. We found, from the lecturer, that this motion of the cones or carbon points was effected by a self-adjusting apparatus familiar to scientific men as the 'Electric Lamp of Duboscq.'

"After these and other experiments with the galvanic battery, the lime light was introduced into the lantern.

"In this case the light is produced by causing an ignited jet of mingled oxygen and hydrogen gases to impinge upon a plate of lime, which, becoming intensely heated, emits a white light of dazzling intensity. This apparatus was used to demonstrate various facts with regard to the composition of light, among other experiments for the production of an ARTIFICIAL RAINBOW. The gurgling sound of the gas rushing through a vessel of water in one part of the apparatus, formed no inapt suggestion of falling showers and overflowing brooks, when suddenly there swept across the whole expanse of the screen, running out beyond it to the extreme corners of the lecture-room, a superb bow, exceeding in brilliancy of color all natural bows that we have ever seen in the sky. Indeed, the glow of color was so intense that it required the turning on of several gas-lights in the room to reduce it to the ordinary lustre of a natural rainbow. Nothing can be imagined more brilliantly successful than this display; and the subsequent exhibitions of polarized light, beautiful as they were, seemed lost in the previous splendor of this wonderful production.

"Our readers, we do not doubt, will be glad to know from the advertisement on another page, that these and other

experiments are to be exhibited to the public on next Tuesday evening, in the Academy of Music, where, among other remarkable features of the performance, a steam engine will be placed under the stage to work some of the apparatus used by the lecturer, thus supplying a power which will enable him to produce results never before reached on this side of the Atlantic."

First Lecture at the Academy of Music. Report from the "Philadelphia Ledger," May 3, 1865.

"A MOST INTERESTING LECTURE."

"Professor Henry Morton's lecture on 'Light,' delivered last evening at the Academy of Music, was attended by one of the largest and most intelligent audiences ever assembled in the building.

"It is next to impossible to give a report of the lecture, for the words of the speaker were illustrated by such frequent application of optical apparatus that mere words will fail to give any adequate idea of either its interest or instructiveness.

"Mr. Morton commenced by showing the analogy between light and sound, and in so doing used what might be called a 'Savarts' wheel for light.

"This was a disk of soft iron revolved by a steam engine, placed for the purpose beneath the stage, at the rate of 6,000 revolutions a minute.

"A steel file being brought against the edge of this disk was rapidly cut through, while a jet of flower-like sparks was projected in a comet-like sheaf to a great height.

"The production of lights of dazzling brilliancy by burning magnesium, and by the calcium and the electric lights, followed; but the most beautiful experiment of all, in this division of the lecture, was the production of light by the passage of a galvanic current over a festoon of platinum, and in what is known as the electric lamp.

"In the concluding part of the lecture, white light was analyzed into its constituent colors by breaking a large arch of white light by means of a prism, and thus forming a beautiful artificial rainbow.

"This having been done, Professor Morton then re-composed white light from colored lights, demonstrating by a variety of elegant experiments one of the most difficult dicta of the science of optics.

"The style of the lecturer is clear and somewhat conversational. His articulation is so distinct that he made himself heard with ease, although he did not appear to raise his voice. Everything was made so plain that we feel free to

say that very few audiences ever assembled in the Academy have been at the same time so well entertained and so thoroughly instructed. Many of the demonstrations were heartily applauded.

"The lecture was announced to be repeated at the same place next Tuesday evening."

First Lecture at the Academy of Music. Report from the "Philadelphia Evening Bulletin," May 3, 1865.

"PROFESSOR MORTON'S LECTURE."

"To see the Academy of Music crowded with a most intelligent audience, on the occasion of a purely scientific lecture on the somewhat difficult subject of 'Light,' is a novelty indeed. The entertainment of last evening forms a marked era in the history of the progress of science in our community, and the enterprise of the Franklin Institute in enabling Professor Morton to demonstrate his subject with a series of beautiful experiments, upon a scale of liberal expenditure hitherto quite unknown in this part of the world, is worthy of all praise. We shall not attempt to follow the lecturer through his remarks, which were delivered with the easy grace of a perfect master of his profession, and in terms

sufficiently simple and untechnical to come within the comprehension of the least informed of his audience.

"The experiments in mechanical, chemical and electric light, were of a brilliant and interesting character, the whole apparatus being of the most perfect and elaborate construction. Frequent bursts of applause testified the delight of the audience as one startling effect after another was produced, and the announcement at the close of the lecture that it would be repeated on Tuesday next was received with the most unmistakable pleasure.

"We would venture to suggest that, if consistent with the success of the experiments, the drop curtain be raised higher and the screen brought a little nearer the front of the stage, as the spectators at the extreme sides of the stage had some difficulty in seeing all the experiments. A word of commendation is due to the efficient corps of assistants, to whose activity and intelligence we were indebted, in great measure, for the absence of all delays in the progress of this delightful entertainment. We recommend those of our readers who missed its enjoyment last night, to avail themselves of the opportunity offered by its repetition next week."

Fifth Lecture at the Academy of Music. Report in the "New York Herald," May 27, 1868.

"LECTURE ON LIGHT."

"An interesting lecture on 'Light,' illustrated with various new and remarkable experiments, was delivered by Professor Henry Morton at the Academy of Music in Philadelphia on last Saturday evening.

"The lecturer is by birth and descent a New Yorker, grandson of General Morton, so well and favorably known among the Knickerbockers of a former generation, and now holds the positions of Resident Secretary of the Franklin Institute and editor of their journal, while at the same time occupying the Chair of Chemistry and Physics in the University of Pennsylvania, an institution corresponding in its antiquity and character with our own Columbia College.

"This lecture is the fifth which has been delivered by Professor Morton in the same place, and had for its special subject, 'Sunlight.' Notwithstanding the stormy character of the night, the house was densely crowded both in seats and standing room; all seats had been sold several days before the lecture.

"To give even an outline of the subject as developed by the lecturer during the two hours for which he riveted the attention of his audience would require far too much space; suffice it to say that the nature of the sun, the source of his heat, and the properties of his light, were most fluently and clearly explained, the various points being illustrated by a series of pictures projected with wonderful brilliancy on an immense screen, forty feet square, covering the front of the stage. The thing that most impressed the audience was the number, beauty, success, and promptitude of the numerous experimental illustrations introduced throughout the lecture. An able corps of assistants, under the direction of Mr. Coleman Sellers, Vice-President of the Franklin Institute, an eminent American mechanical engineer, and famous both in this country and Europe for his inventions and productions as an amateur photographer, placed at the lecturer's hand, or operated at his signal, everything at the moment it was required.

"The lecturer placed himself and apparatus on a platform secured to one of the stage traps, and then was raised to a great height above the floor, at which elevation he burned, in the compound blow-pipe, a sword from point to hilt. The fountain of scintillating sparks and drops of melted steel which, descending in a broad sheet some fifteen feet in height, poured upon the stage and rolled in a torrent of fiery

Burning of a Sword.

hail towards the footlights, was a sight never to be forgotten. A wheel five feet in diameter, supporting electric tubes, was rotated, while flashes of electric fire from the largest induction coil in the world, belonging to the University of Pennsylvania, were passed through, producing a dazzling star of constantly changing colored rays.

"The drop curtain, descending for a few moments, rose again, displaying a brilliant palace scene, illuminated by numerous lime lights judiciously placed. There then marched in a great number of masked figures, in costumes representing the colors of the rainbow, and bearing banners with brilliant devices. These, taking positions, formed a tableau equal in brilliancy and beauty of general effect to anything we have ever seen upon the stage. At a signal the white light was extinguished, and its place supplied by pure yellow light, equally bright, when every trace of color disappeared, and the entire phalanx became a ghastly company of spectres bearing banners of white and black. The means for producing this yellow light is a device of Professor Morton's, entirely new, and eminently efficient; in fact, the entire house was illuminated with it from the stage, so that the same wonderful change was manifest in the faces and costumes of the audience.

"These are but a few of the experiments shown, and repeated and enthusiastic applause testified the natural delight of the audience."

The Plate facing this page represents the final experiment of the lecture above described. It is reproduced from a recently executed painting by Mr. Hughson Hawley, of New York, the details of the interior of the Academy of Music being supplied to this artist by a drawing of this interior made in 1876 by Mr. Frank Schell.

The apparatus by which the flood of monochromatic light required for this experiment was produced, is, perhaps, worthy of a brief description.

It consisted of a group of Bunsen burners, twenty-five in number, with a common gas supply in the shape of a gridiron of iron tubes on which the "burner" tubes rested. Each of these tubes was 18 inches high, and ¾-inch internal diameter.

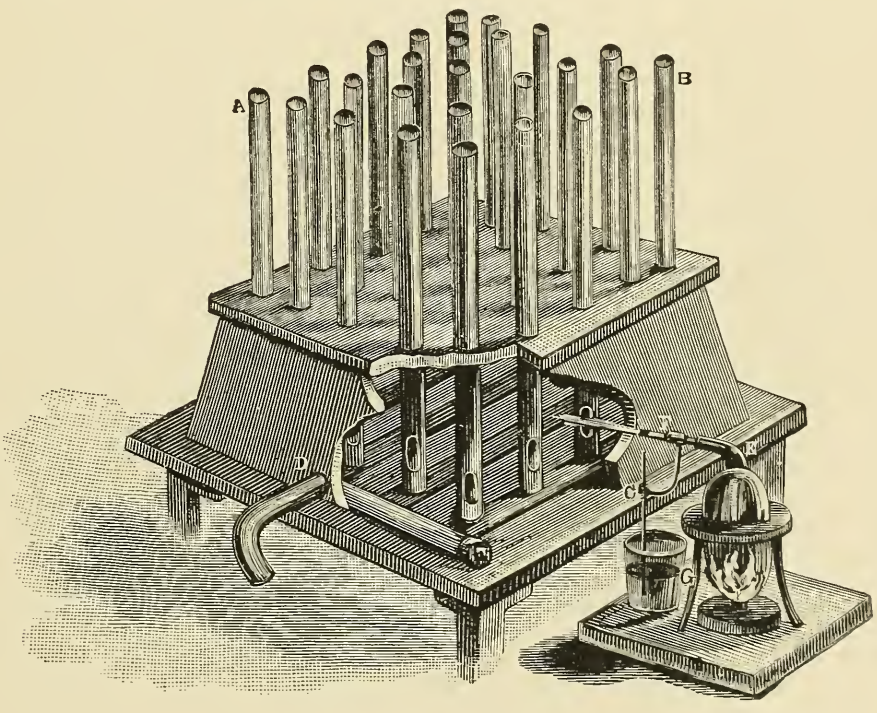
The lower part of this entire system of burners was inclosed in a wooden box with a single large opening in one side, so that all the burners drew their air supply from this box, and consequently through this opening.

Opposite to this opening was placed a steam atomizer, arranged to throw a jet of salt water spray into the box, where, mingling with the air that supplied the burners, it

Experiment with Monochromatic Light at the Academy of Music.

caused them to give out a strong and purely monochromatic yellow light.

In using this apparatus, the steam atomizer was put in operation before the yellow light was desired, but the cup containing the salt water was not raised high enough to feed into the jet. When the yellow light was wanted, this cup was simply raised an inch, and in a moment the pale blue, non-luminous flames of the burners were converted into sources of intense yellow light.



A single one of these groups of burners emitted sufficient light to illuminate a large building, but on the occasion of the lecture described two were used at the front of the stage, with four smaller ones, of five burners each, towards the rear. These are described and figured in Dr. H. Schellen's work, "Die Spectrumanalyse," and in the English translation of the same, entitled "Spectrum Analysis," edited by Dr. Huggins, F. R. S., etc.

Lecture on "Vision." Report in "New York Herald," June 2, 1869.

"VISION."

"Lecture in Philadelphia Last Night by Professor Henry Morton.

"The 'Herald' published last year, about this time, a report, which was quoted in many of our own and several English journals, of a lecture on 'Sunlight,' delivered by Professor Henry Morton, Resident Secretary of the Franklin Institute, before that body at the Academy of Music in Philadelphia. Another lecture, by the same gentleman, and under the same conditions of place and circumstance, but on the subject of 'Vision,' was delivered last evening, and, like the former one, was illustrated with experiments of unusual interest and impressiveness.

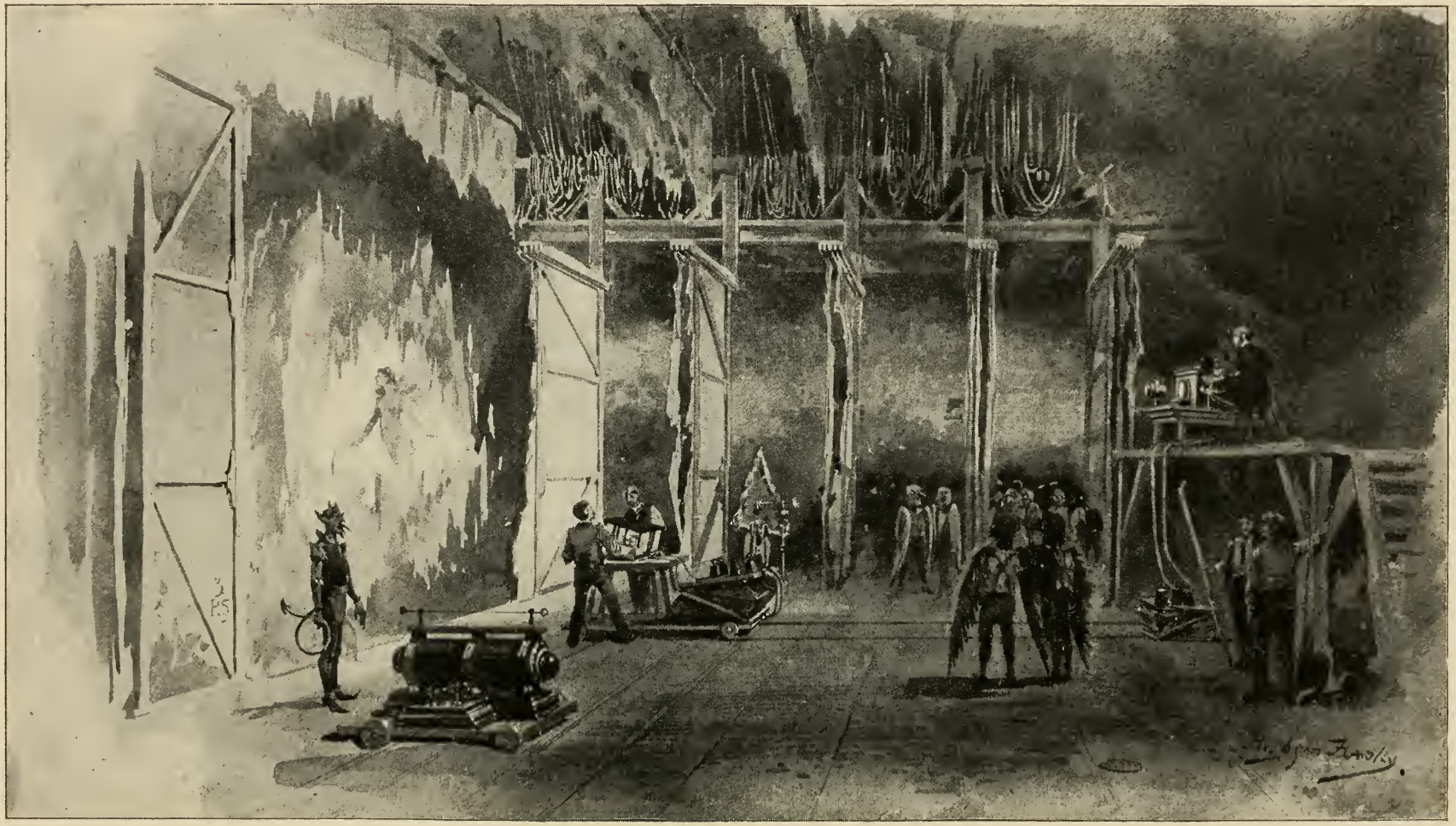
"Professor Morton, though a young man, already holds a high place among our men of science on account of several successful and ingenious investigations which he has carried out, and is, moreover, one of our most successful lecturers, combining a thorough knowledge of his subject with a happy facility of conveying information to his hearers, and a marked ingenuity in the arrangement and execution of experiments, which at once illustrate his explanations and secure the interest of his hearers.

"At a few minutes after eight o'clock, the house being densely crowded as on former occasions, the curtain rose, and the Professor stepped forward and began his lecture with an easy and graceful delivery, speaking without notes and also without mannerism. He explained the structure of the human eye, or organ of vision, in its twofold character of an optical instrument, collecting and arranging light rays like an ordinary glass lens, and of a sensitive nerve screen, receiving and appreciating in many various ways the rays falling upon it. To illustrate the inversion of the image caused by the ordinary lens, a little aquarium was placed behind a lens and illuminated by a powerful lime light, so that a vast image of the aquarium and its inmates was projected on the screen, which covered the front of the stage for a space forty feet square. There then appeared, as it were, a section of the ocean, with whales, sea serpents, and crocodiles, from thirty to fifty feet in length, swimming about on their backs, while the surface of the water, clearly defined, was below, and a fresh quantity poured in was seen to stream upwards from beneath. The vast apparent magnitude of these creatures, and their strange motions, rendered the scene remarkable and amusing in the extreme, as was testified by the repeated applause of the audience, who insisted upon having the aquarium returned to the lantern after it had been removed by the assistants.

"The reason that this inversion did not affect our sense of vision was then explained, on the ground that the nerves of the retina took cognizance of the direction of the impinging rays, and that this body was in fact the seat of vision, the standpoint from which the observation was made, and not a mere screen on which an image was projected and then studied by other means.

"The sensitiveness of the eye to faint impressions of light was then discussed, and in connection with this subject was explained the method of Lockyer and Janssen, by which the solar clouds or flames, heretofore seen during a total eclipse only, could now be viewed at all times. This part of the subject was illustrated by drawings and photographs of total eclipses, taken in 1860 by De la Rue, and last year by Dr. Vogel, projected on the screen. The lantern is now frequently used for such purposes; but we have never seen pictures projected of such vast size, and with such great brightness, as were those used throughout this lecture.

"The method by which the eye judges as to the distance of objects was then explained, and the very limited range of its capacity in this respect was illustrated by the phantasmagoria, in which images always in the same place appear to approach and recede by a mere change in magnitude. This arrangement has been exhibited before, but



Behind the Screen during the production of the Phantasmagoria.

never, we imagine, on so grand a scale or with such remarkable success. The entire space of the stage seemed to be occupied by a vast tunnel, from the far depths of which a locomotive advanced with steady rush, towering up to gigantic size, until, when some 25 feet high, and about to plunge into the orchestra, a whistle sounded, and tunnel, locomotive, and all, melted away into an ocean grotto of the sea nymphs.* From the depths of a vast cavern advanced a grisly skeleton, who, just when he seemed ready to crush the adjacent spectators by his next footfall, waved

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*THE PHANTASMAGORIA.—These phantasmagoria experiments were arranged by having a large magic lantern on an elevated structure at the extreme rear of the stage (which was 60 feet deep), and, with this, throwing large pictures, as of the tunnel, grotto, etc., so as to cover the 40-foot screen at the front of the stage.

On a truck or carriage running at right angles to the screen—that is, back and forth on the stage—were mounted two magic lanterns, with the gas bags, etc., required for their calcium lights. Each of these lanterns was provided with a mechanism by which the adjustment of the lens, securing a sharp image at various distances, caused the opening or closing of a diaphragm which controlled the amount of light passing from the lens to the screen. By this means an uniformity of illumination was secured during the change in size of the image.

Thus, in the tunnel experiment, the view of the interior of the tunnel was thrown on the screen by the large fixed lantern. Then, the lanterns on the truck being close to the screen, a small image of a locomotive, seen from in front, was also thrown on the screen so as to occupy the far-off end of the tunnel.

his arms, nodded, and, turning round, sped back into his dreary tomb. Angels flying forward from a cluster of stars, statues advancing and retreating through vast vistas of colonnades and galleries, and vast colored balls that rolled and unrolled their intricate convolutions, further illustrated the same points.

"There was next introduced, in further demonstration, the 'shadow pantomime,' which would require more space than is allowed in this report to describe, but which we can honestly say fully deserved the enthusiastic applause which it received, and the actual shouts of laughter which it elicited.

The truck was then slowly rolled back on the stage, an assistant standing on the truck keeping the focus right by means of the rack and pinion on the lens, as the image grew larger in consequence of the increasing distance of the lantern from the screen. This adjustment of the focus automatically opened the diaphragm, so that as the image grew larger more light passed out to illuminate it.

When the two lanterns on the truck had reached the most distant part of their movement, the image of the locomotive was so expanded as to occupy the entire screen, and at this moment the "dissolving stopcock" was turned so as to change the light from one lantern to the other, and thus slowly change the locomotive into a nymph.

At the same time that this was being done, a picture of the interior of a grotto was substituted for the tunnel in the large lantern, unnoticed by any one in the confused effect produced by the melting of the other images, one into the other, and thus, when the sea nymph was fully defined, she was seen to be seated, not in a tunnel, but in a grotto festooned with sea weeds and strewn with shells.

"One of the happiest hits was the hatching of eggs by gunpowder, and the vast and rapid growth of the extraordinary fowls produced. The lecturer asked the indulgence of his audience for any compromise of scientific solemnity and formal precedent which this illustration might involve, and we feel sure that none present but might congratulate themselves on his venturing from the beaten path in this particular. We, for our part, shall never forget the at once astonishing and ludicrous effects produced, nor the principles which they illustrate. The immense size of the stage in this building offered for such arrangements unparalleled advantages.

"The subject of persistence of vision was then first illustrated, by large disks six feet in diameter, with devices of balls, rings, etc., painted upon them and rotated, while they were illuminated by rapidly recurring flashes of light.

"All the effect of the best zoetrope was thus displayed to the immense audience with far greater clearness than in the ordinary instrument, for there was no seeming interruption to the view. The great disks stood directly before the house, and were directly viewed with no intervening object. The same subject was also illustrated by several electric wheels, which were decidedly the most beautiful things we had ever seen. One appeared to be a great star, flashing countless and ever changing colored rays; another was an

immense wreath of scintillating, luminous jewels. No words can convey an idea of the beauty of these things, for nothing that one has seen makes any approach to them in their curious combinations, indicated, not expressed, by the words luminous jewels.

"The phenomenon of subjective colors was then illustrated by an arrangement in which one and the same light was made to appear of every color, while actually unchanged. This subject concluded the lecture, which may be reckoned a thorough success, reflecting great credit on all concerned."

Lecture on "Eclipses." Reported in the "Philadelphia Evening Bulletin," March 1, 1870.

"PROFESSOR MORTON'S LECTURE."

"Notwithstanding the unfavorable state of the weather, the audience assembled at the Academy of Music last evening, to hear Professor Morton's lecture on the Eclipse, was as large a one as we ever saw there assembled on a like occasion. Not only were all seats filled, but the steps of the aisles were likewise tenanted, as also the standing places around the walls.

"The lecturer opened his discourse by reference to the enlargement of knowledge, which had deprived the grand and impressive phenomena of eclipses of all superstitious terrors, and taught us to recognize in them, as in all the phenomena of nature, great and small, the operations of a divine and beneficent intelligence and ruling power. He then proceeded to illustrate the facts and conditions from which an eclipse was the consequence, explaining these first by aid of an orrery, in which the place of the sun was supplied by a globe containing a zirconia burner, with twelve double gas jets and as many pencils of this rare substance, and then with a few excellent diagrams.

"After thus illustrating what might be called the astronomical relation of eclipses, he next noticed their purely optical conditions, such as the cause of the umbra and penumbra, or full and partial shadows. In illustration of these points two very beautiful experiments were employed: in the first place, three colored lights of various tints being thrown on the screen, three gigantic colored shadows were projected by a person, atlas-like, supporting a globe. By different movements of this figure and his shadows the various conditions of shade and shadow were clearly illustrated. Then the non-interference and rectilinear directions of light rays were further demonstrated by the 'ascent of the sun spirits.'

In this case, by means of a silhouette, representing a floating figure, placed midway in the stage, and many lights burned behind it, a host of luminous, spirit-like figures were projected on the screen, and, by motion of the lights, were made to float off, rank after rank, into the sky.*

"Passing next to the actual appearance of an eclipse, an illustration was shown whereby all the characteristic actions and changes of a total eclipse of the sun were artificially

* LEGIONS OF ANGELS.—This is an experiment of singular beauty in its effect, and yet of simple execution where the appliances of a deep theatrical stage are available.

A figure, representing a floating winged angel or spirit, is cut out of cardboard or very thick paper as a silhouette, like those used sometimes for lamp shades, but quite large, say five or six feet high. This is supported in a frame, and so connected with stage scenery that it shall be the only opening in an otherwise opaque partition crossing the stage about midway of its depth.

At the very rear of the stage a platform should be arranged at a considerable height, on which several assistants can stand, each one of whom shall hold and burn a piece of magnesium wire or ribbon in such a way that, from time to time, drops of the blazing metal shall be let fall.

The rays of light from each source will pass through the silhouette and project its luminous image on a different part of the wet muslin screen at the front of the stage, thus producing as many "spirits" as there are sources of light, and if these are numerous there will seem to be a phalanx of luminous phantoms across the entire stage. As each burning drop of magnesium falls it will produce an additional image which will *shoot upward into the ceiling*.

This creation and upward flight of luminous phantoms produce an effect whose beauty it is impossible to adequately describe.

reproduced. The bright solar disk was first seen with the sun spots upon it as observed and recorded photographically during the eclipse of last August. Then the moon, with its rugged edge, as shown also in the photographs, crept slowly over, cutting down the solar disk to a crescent of ever narrower dimensions; then came the broken line of light known as Bailly's beads; and lastly, at the instant of totality, or when the last direct sun ray was cut off, came with the suddenness which all observers have noticed, the glories of the corona and prominences.

"To those who, like ourselves, had the pleasure of a preliminary inspection of the stage and its arrangements, this experiment was no less remarkable for its beauty than for the ingenious mechanism by which it was operated.*

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* ARTIFICIAL ECLIPSE.—The apparatus by which this effect was produced may be described as follows: On a plate of glass in a frame, large enough to cover the "field" or "condenser" of a magic lantern, is painted the representation of the sun, surrounded by the solar prominences and the corona, as seen in a total eclipse, except that the sun's disk is to be bright, with sun spots or other features clearly indicated. A little in front of this are arranged two doors, which, when closed, cover everything but the solar disk. These doors are connected with strong springs which tend to throw them open, but are held shut by a catch easily tripped.

Between the glass picture and the doors, slides a long plate of perfectly clear glass, carrying at its centre an opaque disk, with slightly serrated edge, representing the moon and a little larger than the opening between the doors, which last represents the circumference of the solar disk.

"Photographs, obtained at the late eclipse and on previous occasions, were then shown and explained, and the character of the solar prominences and the corona discussed, the former being illustrated by some experiments with colored liquids, and the latter by a splendid display of electric discharges in exhausted tubes. Among these was especially to be noted a phosphorescent garland of blue, green and purple light, which continued to glow for some minutes after the electric discharge had ceased. This tube, the Professor stated, he had carried on from New York in his own hands, to secure

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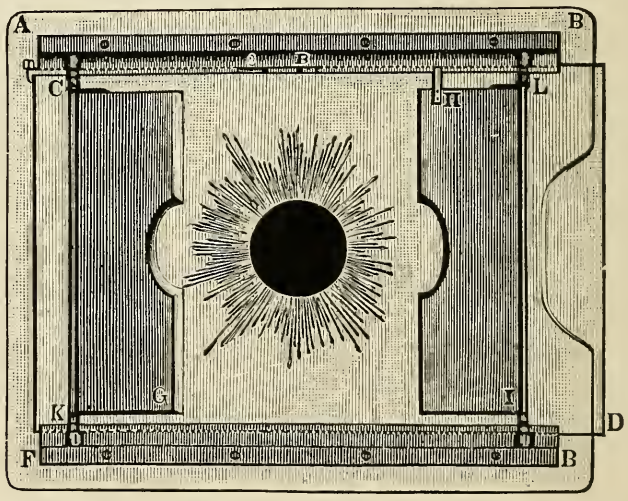
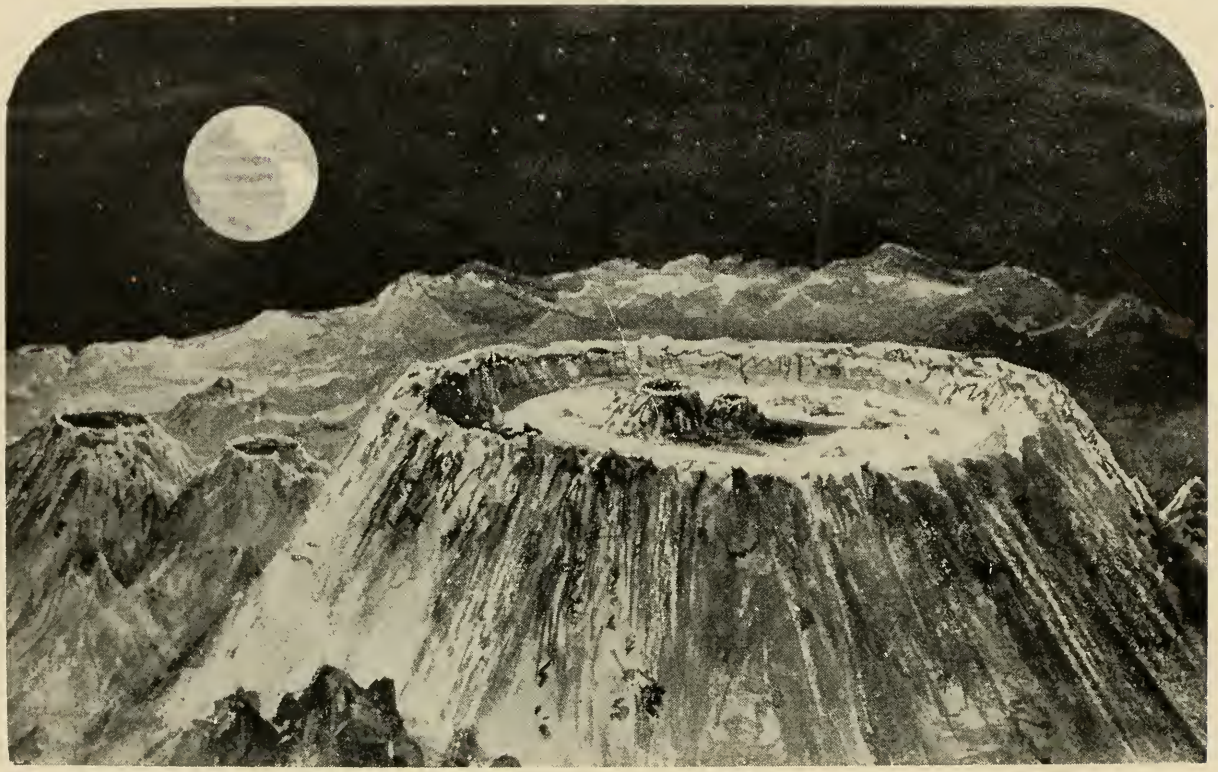
The doors being shut, and the movable glass slide drawn to one side until the opaque disk is beyond the opening of the doors, the apparatus is placed in the lantern, when we see a luminous disk with sun spots alone, on the screen.



The glass slide being then slowly pushed forward, the dark disk of the moon is seen to invade the bright disk of the sun, and little by little to cover it.

Just before the bright disk is completely covered, the phenomenon known as "Bailly's beads" will be represented by the spots made by the light which gets through the serrations on the edge of the lunar disk.

An instant after the totality is complete, the moon's disk entirely covers the sun and at the same moment the "solar prominences" and "corona" flash out, because the front edge of the moving glass slide has touched a rod, which liberates the catch and allows the doors to spring open.



Crater of Copernicus by Earthlight.

its safe transportation in this last but otherwise most perilous stage in its voyage from Europe; and we think its beauty, as exhibited last night, must have repaid him for his trouble."

Lecture on "Sunlight and Moonlight." Report in "The Philadelphia Photographer," 1868, Vol. V., p. 231.

"SUNLIGHT AND MOONLIGHT."

"Professor Morton has on many previous occasions lectured on the subject of light, with equal success and popularity. Several of his previous lectures, like the last, have been repeated, because even this huge building failed to accommodate his audience; he, therefore, in the present instance, assuming that his hearers were acquainted with the general laws governing the emission and reflection of light, proceeded to explain the difference between regular and diffused reflection, illustrating this point by an original and singularly pleasing experiment. A large mirror was set midway in the stage, facing the audience, who could see themselves reflected on its ample surface. Over this mirror an assistant, at a signal, let fall a delicate white veil, when at once there appeared, as if just within the surface of the glass, a phantom-like figure, which was then seemingly wrapped up in the veil as that was rolled together, and appeared to fall with the falling

tissue as it was dropped to the floor. The appearance of this experiment was most beautiful, and excited much attention. The lecturer then explained the method of its arrangement, in which a lantern, with a glass photographic picture placed at one side, and throwing an image obliquely on the mirror, played, of course, an important part.

"Various illustrations projected on the screen, from photographs of statues with mirrors, and landscapes with still water reflecting the adjacent objects, were then used.

"To give such things due effect in such a building is no easy task. The front of the stage is 50 feet in width, and the most distant of the audience more than 100 feet from that point. An immense screen and powerful illumination are therefore necessary. The screen employed was of wet muslin, 40 feet square, lowered into its place at the moment when required. To cover and illuminate brilliantly such a surface (1,600 square feet), no ordinary lantern would suffice, and, accordingly, Professor Morton has had one constructed by Mr. Zentmayer, with condensers eight inches in diameter, and of 3-inch focus, with which pictures of corresponding size are used. Thus an objective of low power may be employed and loss of light avoided, as also a large ignited surface of lime utilized without injury, on account of the corresponding increase of size in all parts.

"After the illustrations of reflection above mentioned, came a series of moon photographs, intermixed with copies of lunar maps and a number of admirable imaginary views of lunar scenery, from drawings prepared by Mr. James Hamilton, our eminent artist, who is so widely known by his marine pieces, and who can produce more apparent motion and commotion on canvas than any one living, we believe.

"These views are of the most impressive description, especially one of the lunar volcano, Copernicus, and its vicinity, as seen by earth light, of which the accompanying Plate facing page 49 is a copy.

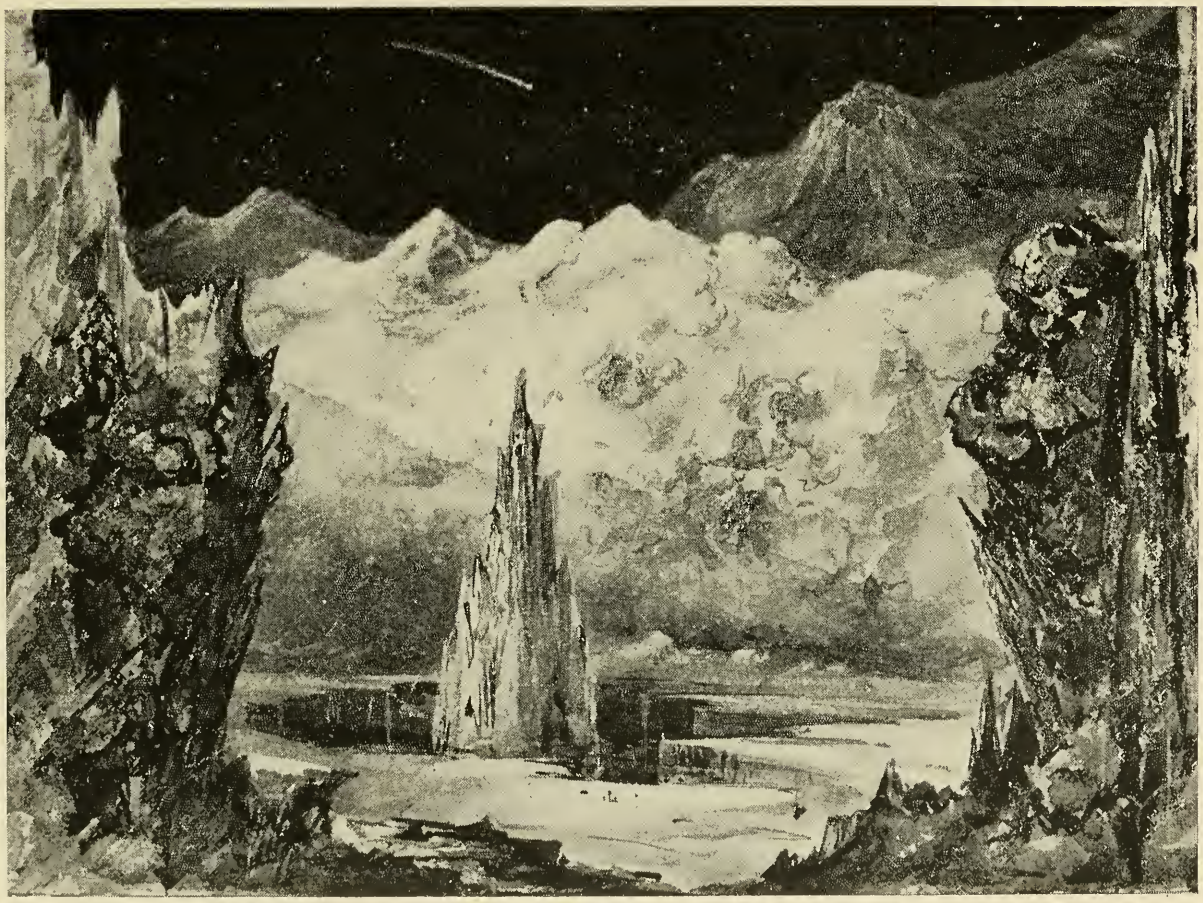
"The direct lunar photographs, by Mr. Rutherford, were also most effective. Thus we beheld, to our great delight, a moon, round and full-orbed, as bright as the original luminary, but rolling on to the screen as a globe of 35 feet in diameter, her mountains and volcanic cones and extended plains distinctly visible. And this was not a mere picture skillfully painted, but a veritable reflection of that orb—the moon's own face, photographed by powerful lenses and magnified by Mr. Rutherford, whose skill in this department is unrivalled.

"The lecturer described and named the various plains and peaks and hilly ranges, as though he had just returned from an exploring expedition to these rocky mountain

regions. We had the Ocean of Tempests, and Seas of Showers, of Serenity, of Vapors, and of Clouds (still called seas, though now known to be arid land wastes), defined and designated, while the heights of the peaks and depths of valleys and volcanic craters were indicated as clearly as those of any earthly elevations or depressions accessible to the foot of the surveyor.

"We felt no doubt, as we listened, that it was all as described, for the photographic fact was before us, and the methods of measurement were explained.

"It was a wonderful and solemn sight, and we acknowledge a debt of gratitude to photography, which we do not expect to pay in full for a long time. To photography, also, the planets are indebted for a personal introduction to the audience assembled on this occasion to receive them. The planet Mars appeared, not as a brilliant speck or point of light, but as a vast, round, silver shield, with the marks of seas and continents distinctly traced. Another photograph, taken an hour later, and lo! the aspect of the planet had altered. A great snow-storm had been sweeping over it. Its majestic mountains and plains had been draped in a winding sheet of frozen rain, and the dark wastes had become white, and the deep seas alone retained their sombre hue. Think of a snow-storm in a distant planet, watched, and fol-



Interior of the Crater of Tycho-Brahe.

lowed, and fixed on glass plates, and presented to an audience, sitting comfortably in the opera house of the city of Philadelphia.

"What is the magnetic telegraph compared to this as a means of communication? It can tell us what is happening in distant parts of our globe, but here is a messenger who comes to us and tells what is happening in the planet Mars, more than thirty-five millions of miles away. The storm signal is hoisted on the coast of England, and mariners know that a tempest is up and at work on the broad Atlantic, and may soon be looked for, howling along the chalk cliffs of the island, and thundering into its bays; but the telescope, and the photographer with his baths and plates, here reveal how a tornado of sleet and snow is sweeping across the plains and oceans of the planet Mars."

September 23d, 9:40. September 23d, 10:25.

A number of these lectures were repeated in the Academy of Music in New York * and at the Peabody Institute in Baltimore †, at the Young Men's Christian Association in Washington, at Providence, at New Haven (before the Yale Scientific Society), at the University of Pennsylvania and at the Stevens Institute ‡ during its first years, when courses of evening lectures were delivered in its large lecture-room (afterwards converted into a workshop) and elsewhere.

In the lecture at the Academy of Music in New York, February 3d, 1871, was shown with remarkable effect, the experiment illustrated in the accompanying engraving.

To produce this a large lantern box was employed having an opening in its front about 10 inches in diameter, from which extended a tube of corresponding dimensions carrying a lens of the same size and about two feet focal length.

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* Transactions of the American Institute,

"The Eye and Vision," February 3, 1871, pp. 295-305.

"On Certain Phenomena of Fluorescence," March 29, 1871, pp. 910-922.

"Nature and Sources of Light," November 23, 1871, pp. 121-132.

† American Journal of Gas Lighting, January 2, January 16, February 2, February 16, March 2, March 16, 1871.

‡ Scientific American, 1872, Vol. 27, p. 403.
" " 1873, " 28, p. 275.
" " 1873, " 28, p. 291.
" " 1873, " 28, p. 343.
" " 1875, " 32, p. 264.

The Living Hand on the Screen. Academy of Music, New York.

At the front of the box, inside and in one corner, was arranged a lime light of unusual power, which threw its rays toward the back of the box, brilliantly illuminating any object placed there.

Of this object the lens threw an enlarged image on the screen. Thus the hand being held within the lantern box, its image was projected on the screen as shown in the engraving, but no picture can give an idea of the effect of relief and reality which this experiment developed. The strong effect of light and shade, the minute detail of every crease in the skin, the natural color, and above all, the motion of the image as the hand opened and closed or made play with its fingers, produced an impression of reality, which, combined with the magnitude, made the shrinking attitude of the figure to the right in the engraving by no means imaginary ; on the contrary, it would require some effort on the part of any one similarly placed to prevent an involuntary retreat from the clutch of the gigantic hand.

Other objects were exhibited with like effect. Thus an apple, seemingly 20 feet in diameter, was shown, cut in two by a knife of proportionate magnitude held in monstrous hands, and its solidity proved by the exhibition of its substantial interior.

The works of a Titanic watch in full action, a lamp with

glass chimney and burning, but upside down by reason of the inverting of the lens, a glass into which wine was poured upwards from a bottle, for the same reason, constitute some of the illustrations used in this connection.

The impression produced by these lectures upon those who heard them is well indicated by a letter which we have selected from a number of others of similar tenor, received by Professor Morton at various times, and the extent to which they were known and appreciated at home and abroad is shown in the letters from Professor Tyndall and Dr. Holmes, which we also insert at this place.

UNITED STATES MINT, May 5th, 1865.

MY DEAR SIR:

I cannot deny myself the pleasure of saying a word about your lecture, at which I was present, with my three children.

It was a superb treat and a complete success. The subject was well handled and finely illustrated, and it must have been some reward for your pains to see such an audience before you.

Such efforts as these will give a fresh impulse to science, where it is somewhat needed—among the mass of young

persons, whose education and refinement should addict them more to the acquisition of knowledge, and less to mere amusement.

Truly yours,

[Signed] Wm. E. Debois.

To

Professor Morton.

Royal Institution of Great Britain, 13th Jan., 1870.

My Dear Sir: I am most heartily obliged both to Mr. Dickson and yourself for the exceedingly interesting series of photographs which you have been good enough to send me.

The marks of kindly feeling which I have received, as exhibited by invitations from the United States, have been particularly agreeable to me, and I propose some day, and that not a very distant one, paying your country a visit. Whether I shall lecture or not must for the present remain an open question. In connection with lecturing I fear two things; one of these, strange to say, is your proverbial American hospitality; the other is that, however lucky I may be in striking, when well and strong, the keynote which suits

the people here, I might not be equally successful among your people. They are accustomed to things on a very large scale, and I, if I dealt in experiments, might not be able to come up to their desires in this respect. I have sometimes thought of preparing a few lectures that I might carry in my pocket, and thus quit experimenting altogether.

I see that as regards light you have already cut the ground away from me.

Whatever the decision may be, I am truly grateful to you for your offer of co-operation.

Yours faithfully,

[Signed] JOHN TYNDALL.

BOSTON, Dec. 6th, 1868.

MY DEAR SIR:

I have heard from Mr. Sellers, and have read in the Philadelphia papers, of your most admirable lectures. I feel very much obliged to you for the attention you have just shown me in giving me the opportunity of learning further of your scientific labors. I have Mr. Rutherford's large photograph, and am delighted to get the engraving with the key to it which you send me. I have also been reading your papers

about the moon with great interest. It is a subject of which I know little, but about which I am very curious. I wish you would do as much for the SUN, which seems to be testing the sagacity of astronomers and physicists just now to a great extent.

I do not consider that I have any claim to be so kindly treated by my distant friends who have distinguished themselves in branches of which I know so little. I can only fall back on my stereoscope, the history of which you will find in one of the next numbers of the Philadelphia Photographer. It is the simplest of simplifications, but it is running a curious career of success. As I gave it away without trying to make money out of it, I may perhaps be allowed a humble place among the benefactors of mankind—by the side of that famous personage who made two blades of grass grow where one grew before, and that other famous personage who found that a straw could tickle a man, and thus become an instrument of happiness.

Thanking you once more very cordially for your kind attention, I am, my dear sir,

Very truly yours,

[Signed] O. W. HOLMES.

During the period (1867 to 1870) over which we have passed in our references to the Academy of Music Lectures, Professor Morton was, in 1867, made Editor of the Journal of the Franklin Institute, a publication of wide reputation and long standing, having been published by the Institute since 1826, and containing numerous original papers and records of classical investigations on Engineering and Scientific subjects, but which had fallen behind in originality and interest.

In taking charge of this Journal, Professor Morton in the first place secured many original papers, of general interest to its readers, from the leading Engineers of the country, and also wrote largely for it himself, preparing each month, under the heading "Items," abstracts of the novelties in Science and the Mechanic Arts which were to be gleaned from publications or reached by direct intercourse or correspondence with those actively engaged in such work.

In 1868 Professor Morton was offered and accepted the Chair of Chemistry and Physics at the University of Pennsylvania, during the year of "leave-of-absence" granted to Professor John F. Fraser, and after the return of Professor Fraser, in 1869, the Trustees of the University divided the work of the department and created a new Chair of Chemistry, which was offered to Professor Morton and accepted by him.

These were years of very varied and pressing scientific activity, including in the year 1869 the organization and conduct of an expedition, under the auspices of the U. S. Nautical Almanac Office, to make photographs of the Total Eclipse of the Sun, as observed on the 7th of August in the State of Iowa. Among the observers of his party were Professors A. M. Mayer, E. C. Pickering and Chas. F. Himes, and the optician, Mr. J. Zentmayer.

In connection with these eclipse observations Professor Morton was the first to prove the TRUE NATURE OF THE BRIGHT LINE ON THE SUN'S DISK ADJACENT TO THE EDGE OF THE MOON, SEEN IN PARTIAL PHASE ECLIPSE PHOTOGRAPHS. A communication on this subject, presented to the French Academy, will be found in the Comptes Rendus for 1869, Vol. 69, p. 1234, and a resumé of the same in Les Mondes, Vol. 21, p. 747, and also in the "REPORT ON THE PHOTOGRAPHIC OBSERVATIONS OF THE TOTAL ECLIPSE OF THE SUN, Aug. 7th, 1869. Supplement to the Amer. Ephemeris and Nautical Almanac, Published by the authority of the Secretary of the Navy." Some account will also be found in the Journal of the Franklin Institute, Vol. 58, p. 373, and in the Chemical News (London), Vol. 20, p. 313.

This matter possesses especial interest because it was a case in which the young scientist was able, by a simple

experiment, to correct an error into which had fallen some of the most eminent men of the time.

The phenomenon in question consists in the presence of a bright line across the disk of the sun, where it is intersected by the edge of the moon, in photographs of the partial phases of an eclipse. The accompanying reproduction from one of the plates in the report published by the Nautical Almanac Office of the U. S. will show exactly what this is.

A similar phenomenon was noticed by Professor Stephen Alexander in 1831 and in 1860, and also by Warren De la Rue in his photographs of the latter date.

It was ascribed by Professor Challis, of Cambridge, England, and by Professor Alexander, of Princeton, U. S., to a very rare lunar atmosphere. De la Rue and the Astronomer Royal of England (Professor Airy) had explained it as a SUBJECTIVE EFFECT not really existing in the picture, but developed to the eye by contrast.

President F. A. P. Barnard, of Columbia College, explained this phenomenon as the result of diffraction, and experiments were made at the Army Medical Museum, Washington, which seemed to support this theory.

President Morton, however, showed by experiments absolutely conclusive, that this was simply the result of a local re-development, and was, therefore, a photographic phe-

Solar Eclipse. August 7, 1869.

nomenon, and not an optical one, going on entirely in the dark room of the photographer during the "development" of the negative.

The estimation of the work done in connection with this eclipse expedition, by the highest scientific authorities of Europe, is shown by the following letters. Two letters from Professor Airy, the Astronomer Royal of England, are given because they show in an interesting manner how he was convinced of the accuracy of Professor Morton's explanation about the bright line, after reading his paper on the subject, although he doubted it when first announced:

ROYAL OBSERVATORY, GREENWICH,
LONDON, S. E., Oct. 6th, 1869.

PROFESSOR HENRY MORTON:

SIR: I have to thank you for your valuable and most acceptable present of three photographs of the solar eclipse of 1869, August 9. They are excellent! I have them framed and glazed, and they will be suspended in one of the official rooms of the Observatory for the gratification and instruction of astronomical visitors. And at the same time I have to thank you for the two pamphlets (Journal of the Franklin Institute, No. 525, and the Philadelphia Photographer No. 69), which accompanied them.

There must be something unusually favorable to celestial photography in North America. I know not whether the air is more free from irregular currents, or the instruments firmer, or the manipulators more cool. We have no photograph of the moon like Dr. Rutherford's, and I think none of total eclipses as good as these.

I remark in page 209 of the Journal you allude to the apparent brightness around the dark moon. I would ask you to refer to the monthly notices of the Astronomical Society (if at hand), 1863, Nov. 13, page 13, etc., and (in the same volume), 1864, June 10, page 188, and to repeat the experiments mentioned there. You will find that the apparent bright band can be produced at pleasure, when there is no possibility of explaining it by any chemical action on the paper. I am, sir,

Your faithful servant,

[Signed] G. B. AIRY.

ROYAL OBSERVATORY, GREENWICH,
LONDON, S. E., March 28, 1870.

PROFESSOR HENRY MORTON:

DEAR SIR: I ought long ago to have acknowledged receipt through Mr. Crookes of the negative photographs of experimental eclipses tending to explain the luminous band

around the moon. And I have now driven my answer into a time when I have hardly a moment free. I think that you have made a most satisfactory and most convincing investigation on that subject. You have certainly shown that a large part of the appearance, possibly the larger part, is due to the photo-chemical action which you have so clearly traced. I find, also, that a part is due to the ocular cause which I indicated. It is curious that they should have so co-operated as to induce some persons to look to a totally different origin. I am, dear sir,

Yours very faithfully,

[Signed] G. B. AIRY.

The next letter is from Warren De la Rue, who may be regarded as the father of Astronomical Photography, and who conducted an expedition to Spain in 1860, to make photographs of the total solar eclipse which was visible on that occasion:

THE OBSERVATORY,
CRANFORD, MIDDLESEX, W., Jan. 1st, 1870.

MY DEAR SIR: I am ashamed of having run into a new year without having thanked you for the two series of beautiful photographs you so kindly sent me, and also for the

very courteous and flattering letter which accompanied them. I have no valid excuse to offer for having so long delayed writing, and therefore throw myself on your kind indulgence to excuse me.

When your letter of August 30th, '69, reached me, I had just returned, after an absence of a year, to my house and was much engaged in putting my observatory and other matters into order. Time has run on so fast since then that I can scarcely realize the fact that about three months have elapsed since the glass positives came to hand.

Permit me to congratulate you, and all the gentlemen connected with you, on the eminent success which has crowned your enterprise ; nothing could be more perfect than the sun pictures and the totality pictures ; they are extremely beautiful specimens of astronomical photography.

I notice in both series the same configurations of soft light, which is important as proving that a part, at least, of the corona belongs to the sun ; for in both series one can trace the covering and uncovering, respectively, of those portions which have a distinct though faint outline.

I remark that the sun pictures and the partial phase pictures were taken with the object-glass stopped off to one and one-half inch diameter; it would be important, with a view of obtaining data for observations of the transit of

Venus, to ascertain whether or not the whole six inches can be used with good definition by causing the instantaneous slide to flash across the axis with greater rapidity. As the telescopes and their photographic apparatus are still, no doubt, available, you would do good service if you could settle this point at an early date. Some of the observations will have to be made with the sun at a very low altitude, and all the aperture of the telescope will have undoubtedly to be employed in order to obtain photographic records. It would be very desirable to have a concerted plan and division of the work between the governments who propose to take part in obtaining photographic records of the transit of Venus in 1874. Do you know whether your Government proposes to organize photographic expeditions ?

To return to your photographs: With respect "to the increase of light on the solar surface, where it is in contact with the edge of the moon," which, with some hesitation and a reservation, I ascribed, in my paper on the total solar eclipse of 1860, to an effect of contrast of light and shade, Mr. Stone makes the following suggestion:

"Nov. 15, 1869.

"My Dear Sir: The following very simple explanation of the bright ring of light around the moon's edge in solar

eclipses appears to me satisfactory. Near the boundary of the shadow we have superimposed the light received on the moon's edge at a grazing angle and then scattered. This, added to the direct light, would give rise to a belt of greater intensity such as that shown in the photograph.

[Signed] "E. J. STONE."

There is a difficulty in accounting for the bright ring of light by attributing it to the effect of an atmosphere surrounding the moon.

I had the pleasure of forwarding to you by book post, two early copies of Major Tennant's paper; one for yourself and the other for Professor Coffin. I had been engaged for several months in superintending the engraving of the fac-similes of the totality pictures, and hoped to have been able to send you the paper earlier, but several impediments prevented my doing so.

Now, I beg to tender you my very best thanks for your kindness in sending me the earliest prints of your eclipse expedition, and for the very handsome acknowledgment of my previous labors. I set the greatest store on your very courteous letter, and fully appreciate the noble sentiments which prompted you to acknowledge the value you ascribe to my labors in astronomical photography.

With kindest wishes for your happiness in this and many future years, I am, my dear sir,

Yours most sincerely,

[Signed] WARREN DE LA RUE.

TO PROFESSOR HENRY MORTON.

To the same period belong many other papers on optics and mechanics, including an account of the Zentmayer Lens,* Monochromatic Light,† the Giffard Injector and Ejector Condenser,‡ and various reports to Les Mondes.§

Professor Morton's paper on the Giffard Injector was written at the request of the firm then controlling the manufacture in this country of this invention, considered by many as a mechanical paradox, notably so by those who were unable to understand its mode of action. A Scotch mechanic of considerable practical skill, who was sent to Paris by his English employers to report on this instrument, brought home a clear account of its form and operation, but when asked to explain the philosophy of the propulsion of water by

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* Les Mondes, Vol. 15, p. 492.

† Ibid., Vol. 17, p. 133.

‡ Journal, Franklin Institute, Vol. 56, pp. 54, 124, 194; Vol. 58, p. 291.

§ Vol. 21, pp. 72, 205, 228, 593.

a steam jet into a boiler of greater pressure than the one that furnished the steam, answered the question as to what makes it work by the positive assertion, "The will o' God, mon, the will o' God."

Now, the "will o' God," as manifested in this and in many other remarkable discoveries, found in Professor Morton an exponent who could make clear to the most ignorant the laws that not only govern the Universe, but also govern such minor applications of these laws as constitute the remarkable inventions that from time to time, in rapid succession, are brought to public notice. Before we become accustomed to the discoveries that we cannot understand and cease to wonder at them on account of our familiarity with them, there is needed somebody who is capable of making clear to the unscientific the principles that govern them; and in this regard few have equalled Professor Morton in his method and in his diction.

We have seen how Professor Morton's first vocation to scientific work was in connection with the movement to cast aside the time-worn traditional methods of scholastic training and to substitute in their place those new methods of class-room and laboratory experiment and research which to-day have won for themselves universal acceptance. The Chair of Chemistry in the University of Pennsylvania opened up for

him a still wider field of labor in this direction, and the teaching of the text books were enlivened and brought abreast of the passing hour by his reports of contemporary scientific progress, published month by month in the columns of the Institute Journal.

But the hour had now arrived when, by an unlooked for opportunity, he was enabled to prosecute this vital reform in the system of education on a far wider field than that presented by the limited sphere of a college professorship, and at the same time to find scope for the exercise of that aptitude in the management of men and affairs which had been so successfully displayed in the resuscitation of the Franklin Institute and elsewhere.

At the time referred to, the teaching of industrial and mechanic arts by the Franklin Institute and other institutions had nowhere attained the dignity, or led to the foundation, of a school professedly dedicated to the science and art of mechanical engineering, nor indeed was this department, aside from civil and mining engineering, recognized by a separate title or honored by an appropriate academic degree. By the munificence of Mr. Edwin A. Stevens, a great gift of land and money had been devoted to the endowment of an "Institution of learning," but the precise form which that institution should take had been wisely left to the discretion

of a Board of Trustees. Appointed by this Board in 1870 to the position of President of the Stevens Institute of Technology, Professor Morton, with the cordial support of the Trustees, and with the counsel and advice of many eminent engineers, entered upon the task of making the Institute the first school whose exclusive business it was to teach Mechanical Engineering as a profession.

At the stated meeting of the Franklin Institute, held June 15, 1870, Professor Morton tendered his resignation as Resident Secretary, having accepted the Presidential Chair of the Stevens Institute.

The late Mr. Robert Briggs, in moving the acceptance of this resignation, proposed a vote of thanks that to the mind of the then President of the Institute, presiding at that meeting, expressed in a few words the good work that had been accomplished by the retiring secretary.

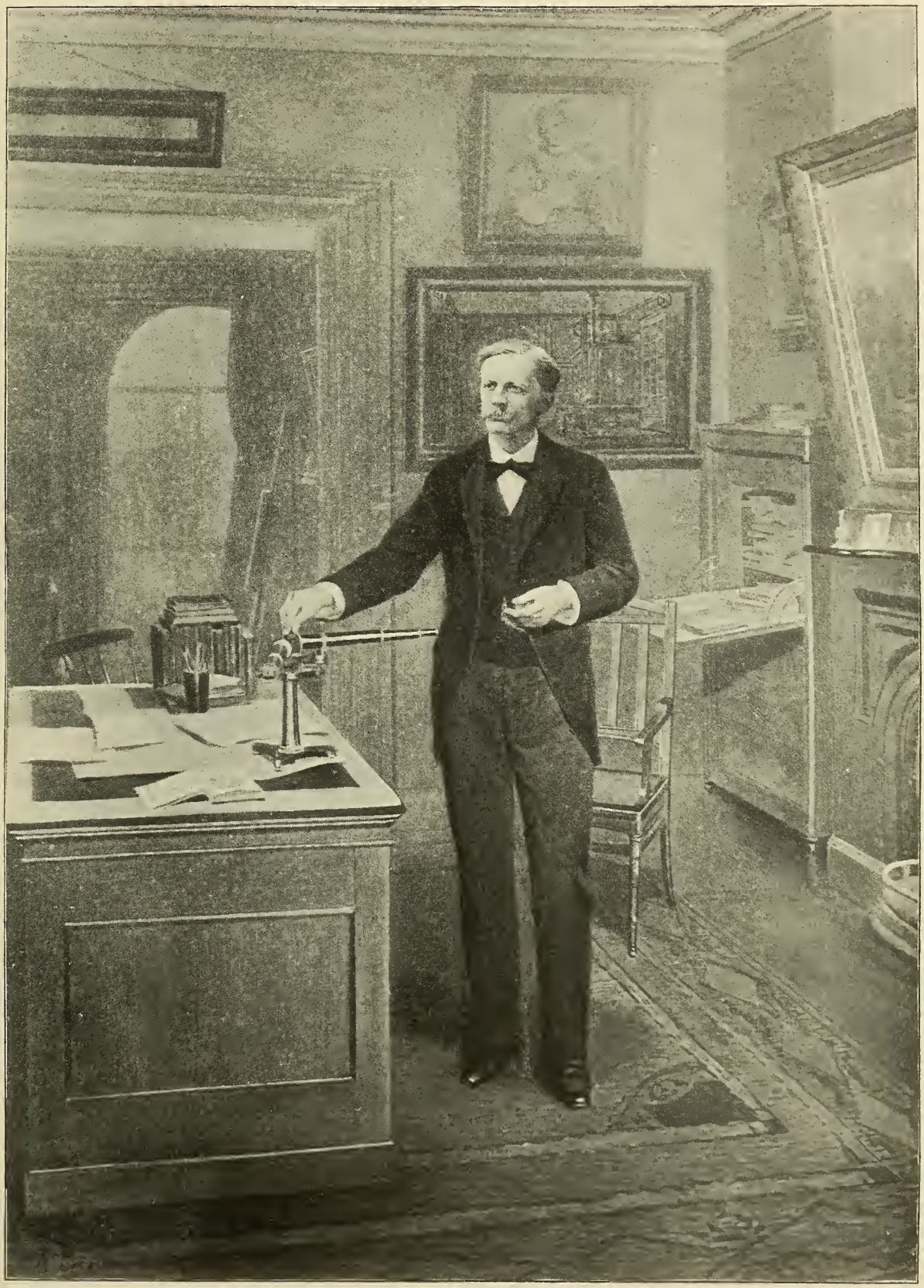
"The assiduity which he had shown in advancing its welfare, the skill and ability with which he had, step by step, awakened the members to an estimation of the utility of its purposes, the share he had taken in instructing the members in its meetings, the furtherance of the objects of the Institute in other cities and in foreign lands, had been the noteworthy characteristics of his direction. Besides these successes in administration, he had performed a yet

more valuable service for the Institute, in the establishment of the present position of the JOURNAL as the leading engineering paper of the United States. An institution like ours lives in its record, much if not most of its valuable additions to science are the results of study, and are not, except to special audiences, suited for oral communication. The practical man has already learned, that often what he wishes especially to know, has been studied and discussed and is in print, and if his steps lead him into regions where he finds no footsteps, it is then his turn to lay out a route and to describe and point out the path for future travelers. The record of an institution like ours is worth far more than any popular meetings. Under the editorship of Professor Morton, the JOURNAL has reached an excellence of original articles, which its warmest friends hardly expected it to attain."

At the time when President Morton took charge of the Institute, he formulated such a provisional working plan for the conduct of the future school as the needs and knowledge of the hour suggested. This plan was purposely left flexible as to its details, and from that time to this present occasion friendly criticisms have been asked for, from Trustees and Faculty, from Alumnus and Student, from the engineering profession at large, at home and abroad, and the results of

those criticisms, after discussion and trial, have been incorporated, where approved, in many departments of the Institute, with the result that the wisdom and sagacity evidenced in the beginning, stand vindicated in the light of the knowledge and results of to-day. While the Stevens Institute stood alone 20 years ago, there are now in this country a score of institutions where Mechanical Engineering is taught, but the Institute still holds its leading position ; while the original plan has been modified in many details, the changes have been those of evolution and development, not those of abandonment or departure ; while the infant institution of 1870 was an experiment of whose eventual success or failure no one could speak with confidence, the Stevens Institute of 1891 is a strong youth who has just attained his manhood, and may look with a not unbecoming confidence to a long future of vigorous growth and usefulness. With all of this past, with as much of this bright future as his years and strength allow, President Morton is and will be identified ; the Institute is his MAGNUM OPUS and will remain his enduring monument.

But to write of this part of his life is largely to chronicle the history of the Institute, and that pleasant task must be left to other pens and places. It will be possible in this place merely to advert very briefly to the generous gifts President



Portrait of President Henry Morton, Ph. D.
By A. D. Turner, from a photograph taken in 1881.

Morton has made, and which have enlarged the scope and usefulness of the Institute, and then it will be necessary, in the brief limits of the present memoir, to return to a consideration of his scientific labors.

In 1880 he presented to the Trustees of the Institute a new workshop, fitted up with steam engines and machine tools, at a cost of over $10,000.

On the occasion of the formal presentation of this workshop to the Trustees, May 14, 1881, Professor R. W. Raymond, M. E., in the course of an address, said as follows:

"Various modifications of this combination of theory and practice, including more or less of the Russian system of instruction in shop work, have been tried in different schools of engineering, but never under so favorable conditions as the present. With characteristic caution and good judgment, President Morton has studied the operation of the scheme of instruction adopted in the Stevens Institute, and, noting its deficiencies, has now supplied them with munificent liberality, giving to it a completeness that leaves seemingly nothing that could be improved upon, even in a prayer or a dream. Still, no one will be more ready to admit than he who has done all this, that it is not enough to fit up a machine shop, be it never so complete, and light it with an

electric lamp. The decision as to its efficiency must come from the students that are so fortunate as to be admitted to it. If such young men, earnest, enthusiastic, with every incentive to exertion and every advantage for improvement, here, where they can feel the throbbing of the great heart of enterprise, within sight of bridges upon which their services will be needed, within hearing of the whistles of a score of railroads and the bells of countless manufactories which will want them; if such as these, trained under such instructors and amid such surroundings, prove to be not fitted for the positions waiting for them to fill, it will have been definitely demonstrated that the perfect scheme is yet unknown."

On the same occasion, Horatio Allen, M. E., said, in the course of his remarks, as follows:

"I was once appealed to by a rich man for advice as to the shop to which to send his son, who had a great desire to be a mechanical engineer. My advice was, that as money was not the consideration, he should not send him to any shop, but that he should provide, by purchase or hiring, the command of tools, machines and power, to be used under experienced guidance, and thereby attain the knowledge as to tools, machines and power, that was to form a part of his education as a mechanical engineer, and, at the same time, to

give, under experienced guidance, such attention to what is to be learned from books and the drawing-board and its instruments as is specially required in his future life as a mechanical engineer.

"The personal knowledge as to tools, machines and power, that is provided for by the presentation of this evening, is to supplement the knowledge from books provided by the Institute.

"But, like all other means, its value will depend greatly on the will and attention of the student, and in no small degree on the good judgment by which the use of the means provided is guided."

On the same occasion Coleman Sellers, E. D., in the course of his address, after alluding to President Morton's previous experience and views as to the needs of technical education, said as follows:

"There is one direction in which I have always found him particularly strong, and that is in his caution in conducting experiments and in his careful selection of methods. He has always looked upon this scheme of educating mechanics as one that must be tried in such a way as to make each step in the process of experimentation a step in advance. He tells you what he has had in view, and he calls on me to say what I think of the plan—a plan to carry out which he him-

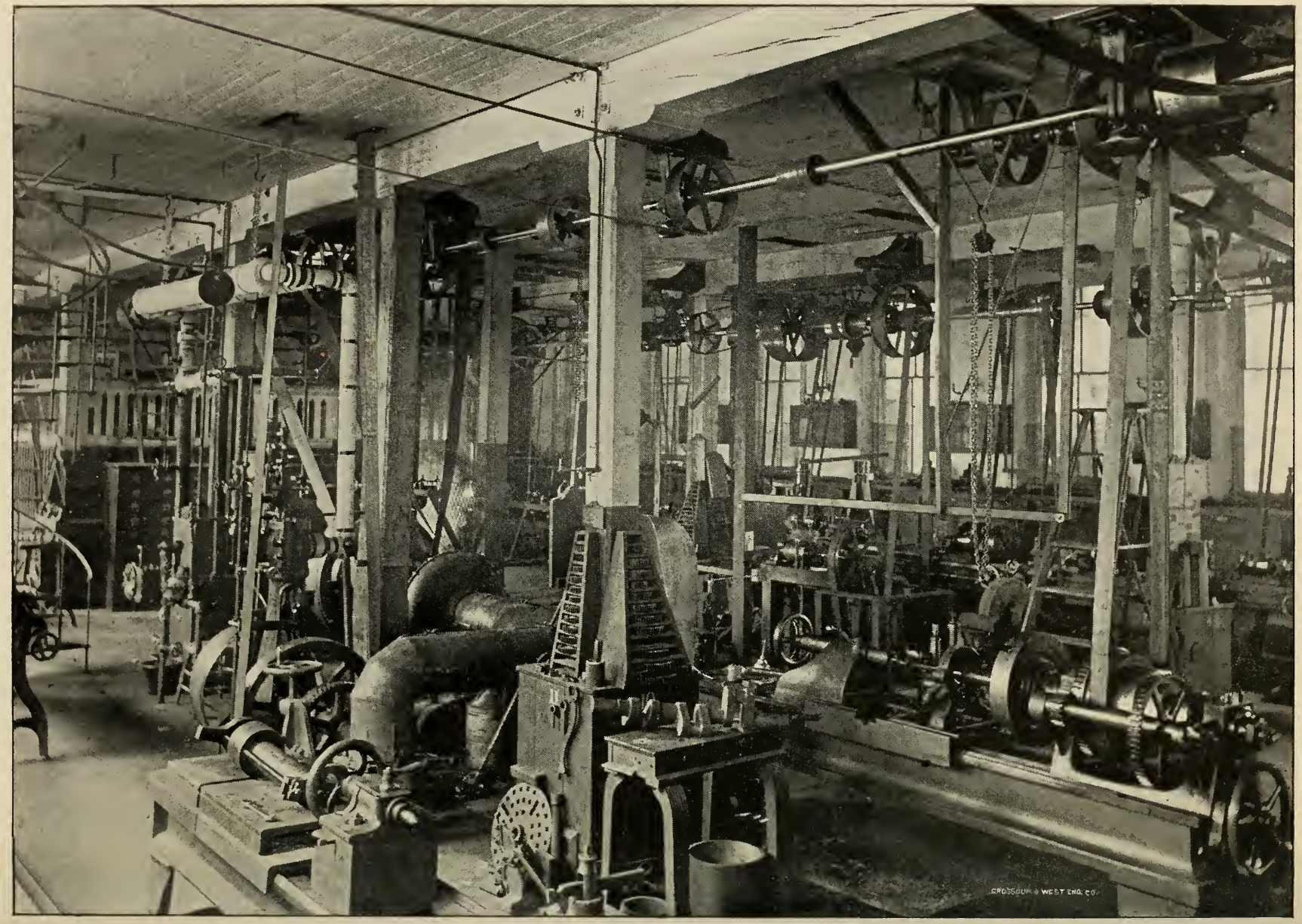
self has, with commendable liberality, furnished the wherewithal.

"Measured by his own pecuniary ability to make such a gift to the world as he now conveys to the keeping of the Trustees of the Stevens Institute, it is a truly munificent gift. Measured by the results that are likely to be attained by its use, it represents a still greater value. That such results will be reached, we have every reason to expect, for this is the outgrowth of what has been of use in a smaller scale, and it presents a possible elasticity that will make it bend to what is found to be of the most value, or what will produce the best results as the experiment progresses.

* * * * * *

"I have carefully considered all the problems involved in this scheme of teaching, and cannot but predict the happiest results.

"President Morton's gift is not to the Stevens Institute alone—it is to the world; and it behooves those who have the interest of the rising generation at heart to aid in all ways possible in the success of this enterprise. As one of the mechanics of America, I thank President Morton for his gift, rejoicing that another door has been opened for those who would add to our country's prosperity by aiding in the

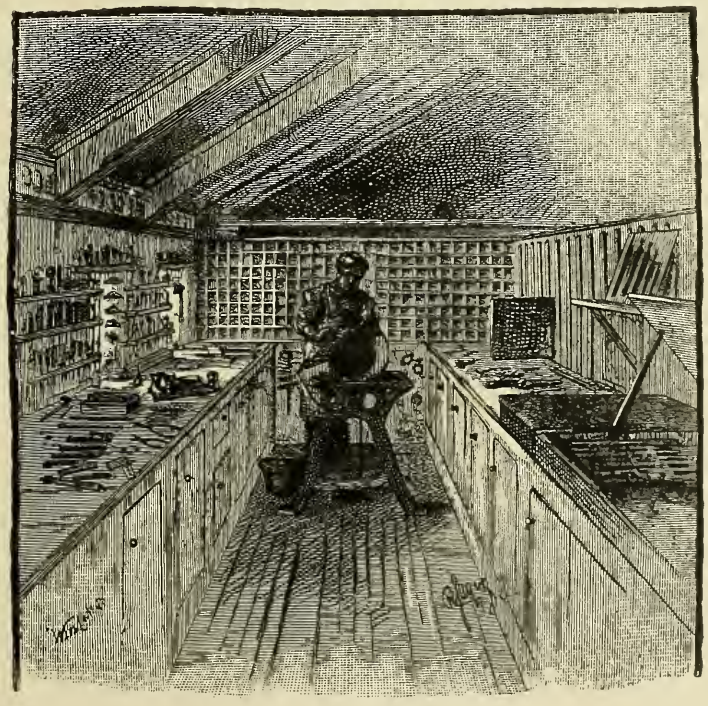


Workshop.

increase of her production. For it is only to education well applied that we must look for continued progress in competition with the nations of the world."

The experience of the ten years which have elapsed since the time of these addresses, has abundantly confirmed the most sanguine anticipations therein expressed and has dissipated every shadow of the doubt at that time entertained as to the practical success of the original experiment then inaugurated.

The Plate facing this page shows the workshop substantially as it was at the time of its presentation, with the exception that the "tool-room," at first located in the gallery, or upper shop, as shown in the adjacent cut, was moved down to the rear of the main floor.



In 1883 the introduction of electricity into the domain of Mechanical Engineering, by reason of the remarkable discoveries and applications of this remarkable form of energy,

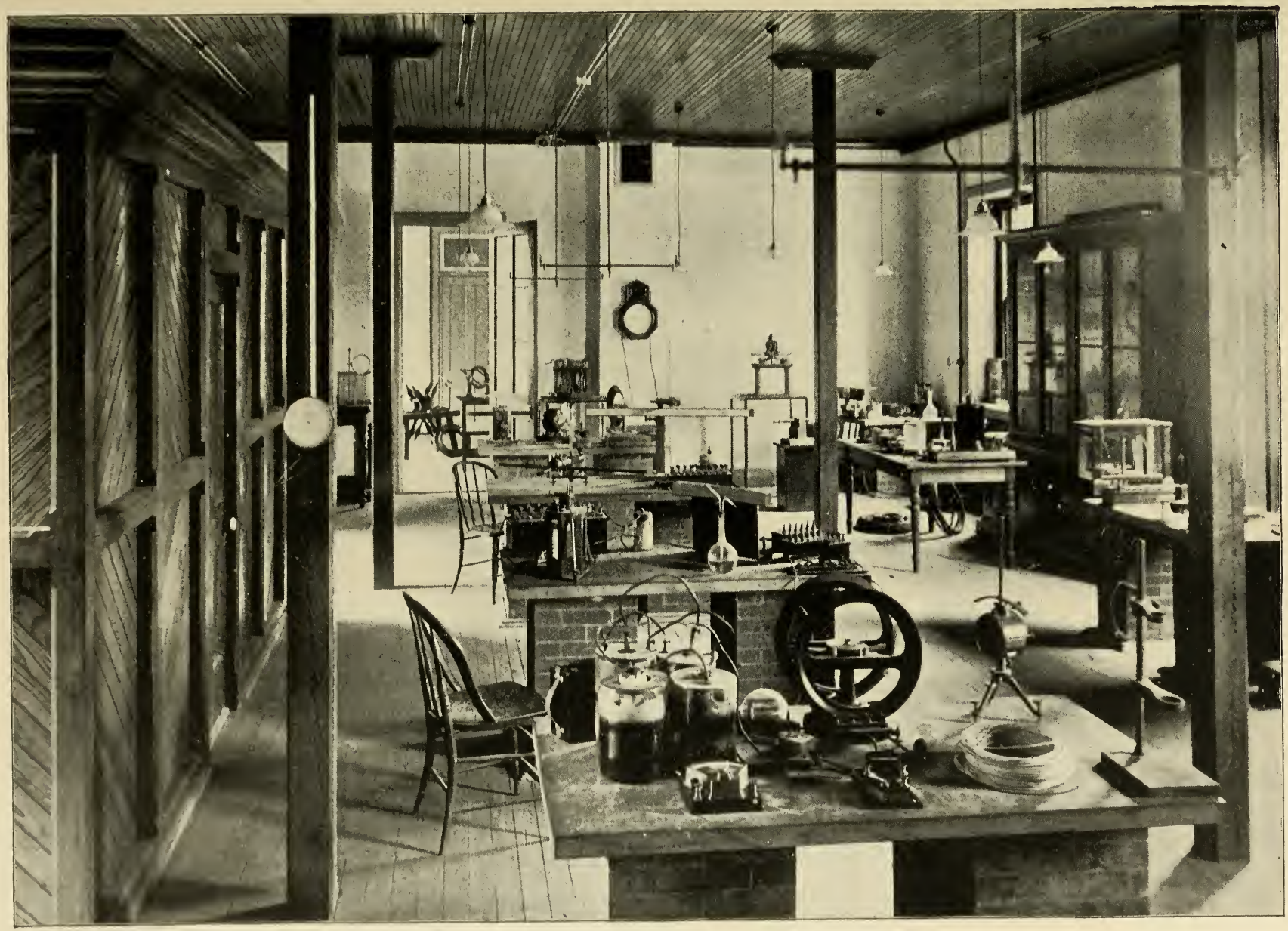
rendered it desirable that a new branch should be added to the Institute, for the purpose of giving the practical information on this subject which was becoming needful for the thoroughly equipped Mechanical Engineer.

The very success of the institution in the direction of increase in the number of students instructed, and the enlargement of the field of instruction in practical directions, had, however, rather crippled than increased its financial resources.

The higher technical education has never been a matter of financial profit, but has always been dependent upon private or public endowments for a large part of the means necessary to carry it on in an adequate manner, and the relatively modest endowment of the Institute had already been stretched to cover an amount of work far beyond its capacity, as measured by what had been elsewhere accomplished in similar cases.

Such being the case, it was fortunate that President Morton was again able to supply what was so much needed, by establishing the Department of Applied Electricity.

This he did by giving $2,500 for the purchase of electrical apparatus and machinery, and guaranteeing the salary of the professor who should take charge of this department.



The Electrical Laboratory.

In recognition of this timely action, the Trustees established the Morton Scholarship.

Plate XIV. shows interior of the Electrical Laboratory as it was arranged in 1888.

In 1888 a Chair of Engineering Practice was established, in reference to which we here quote from the report of the Alumni Trustee, Mr. Alfred P. Trautwein, M. E., presented at the meeting of June 13, as follows:

"It will be particularly gratifying to your body to learn how the expense necessary to sustain this Chair will be met. President Morton, with his open-handed and characteristic munificence, has placed at the disposal of the Trustees the sum of $10,000, as the first installment towards an endowment fund which shall sustain this Chair. In doing so, Dr. Morton has added one more to the many evidences which he has given us in the past—in his equipment of the workshop, his establishment of the Department of Applied Electricity, and in many other ways, which, with his characteristic modesty, he has never allowed to become known—of his deep regard for the advancement of the material interests of the Institute."

In this connection it seems not inappropriate to quote from the valedictory address delivered at the Commencement,

on the following day, by Mr. Burton P. Hall, M. E., certain passages addressed to President Morton, as follows :

"To your guidance and instruction we owe a fund of knowledge which has proved indeed a valuable contingent throughout our college career. And although we have been favored with your personal instruction during only one year of the course, and that the first, we still have never ceased to feel its influence. Nor have we failed to recognize and gratefully appreciate the kindly interest, the lenient justice that you have ever exercised in our behalf. And those of us who may have been at times deserving of your admonition can truly say, and with a heartfelt gratitude, that while in potency it never has been lacking, it has been robbed of all unpleasantness by being graciously administered, thus pleasantly eliminating that spirit of resentment that might be prompted to arise.

"The duties imposed by our curriculum, when faithfully performed, give little opportunity for social life, but by your encouragement and generous personal assistance, you have ever rendered it an easy privilege to partake of the enjoyment of what social life our leisure time would grant.

"You have made us welcome at your home, and have entertained us with a free and open hospitality that we have

ever gladly accepted, counting it a pleasure and a privilege to be recipients of a favor so cordially extended.

"The social happenings which have marked our college life and which still remain as bright and happy reminiscences, owed much of their success to you. You encouraged us by your presence and ever stood in readiness to grant us aid.

"In all the varied phases of our student life, we have shared that generous interest which you have ever bestowed upon our Alma Mater and her students. For the many benefits received as such, for the never-failing kindness and consideration given us, not only in the exercise of your official duties, but beyond the college walls as well, we return our deepest gratitude, and with many, many feelings of regret, we bid farewell."

At the meeting of the Alumni Association, February 15, 1892, President Morton, in connection with the subject of subscriptions for the new building, announced his intention of soon placing in the hands of the Trustees the sum of $20,000 in five per cent. bonds for the further endowment of the Chair of Engineering Practice, the interest to be used for the new building until the cost of the same was paid.

In 1878 the position on the United States Light House Board, vacated by the death of Professor Joseph Henry, was

offered to President Morton in the terms of the following letter, and accepted by him :

TREASURY DEPARTMENT, May 22d, 1878.

PROFESSOR HENRY MORTON, President of the Stevens Institute of Technology, Hoboken, N. J. :

SIR : I have the honor to inform you that the President has authorized me to tender to you the position of member of Light House Board, made vacant by the death of Professor Henry.

The law prescribes that two members of the Light House Board shall be "civilians of high scientific attainments," and your acknowledged qualifications more than meet the legal requirement.

Although no pecuniary compensation is attached to the position, it is one of considerable honor, and has a certain National conspicuity, while the duties cannot be considered arduous, and would not probably interfere with your functions as President of the Stevens Institute. These duties would require your attendance, not, however, invariably, nor unless upon special urgency, at the quarterly and annual meetings of the Board, all traveling expenses being, of course, reimbursed; and, at certain times, the conducting of scientific experiments, for which ample facilities are provided at the

laboratory on Staten Island. For the making of these experiments, which relate chiefly to illuminants and sound signals, your proficiency in general physical science and your well-known researches into the laws of light and the properties of oils, especially fit you. I hope, therefore, that you may be induced to accept the proffered position, and thus give to the Board services which, I assure you, will be no less prized than valuable. I have the honor to be,

Very respectfully,

[Signed] JOHN SHERMAN, Secretary.

President Morton was made Chairman of the Committee on Scientific Tests in the Board, and in this capacity conducted numerous tests on fog signals, illuminated buoys, fire extinguishers, electric lights, etc.

At the opening of this sketch, we noticed the generous hospitality for which General Jacob Morton was distinguished, and, as an illustration of an hereditary trait, will here insert a paragraph from a report of a meeting of the American Institute of Mining Engineers, which appeared in "Engineering" (London, England), June 7, 1889:

"After this genesis" (alluding to a paper entitled "The Genesis of a Nail"), "there was naturally an 'exodus,' for the Institute had been invited to lunch at Dr. Morton's house.

The writer is ignorant of the number of scientific societies to which this pleasant and hospitable gentleman, President of the Stevens Institute, belongs, but, having the honor of belonging to three of them with him, he can testify that the President never misses the chance of a meeting in New York to invite them to his house, and, as they always enjoy it, the invitation is never declined.

"If the Doctor belongs to many societies, it must keep him in a constant state of reception. Still, he seems untiring, and if he has as good a time as his guests, it is to be hoped he will continue this delightful practice."

Soon after his settlement in Hoboken, President Morton was called upon for advice and assistance as a scientific expert in connection with an important patent litigation, having reference to the use of carbolic acid in the manufacture of the canvas and rubber hose so extensively employed by the fire departments throughout the country.

In this case a great deal depended upon a sample claiming to be a portion of the carbolic fluid with which some canvas had been treated many years before On examining this sample, President Morton was led to suspect its genuineness, and, after a thorough and extensive investigation, was enabled to prove that such a material as constituted the sample could by no possibility have existed at the date

claimed, but must have been produced by the admixture of materials some of which had only been manufactured recently.

The investigation by which this result was arrived at required the devising of several new tests and the examination of a large number of substances containing carbolic acid, obtained from all parts of the country.

Soon after this, President Morton was called in another patent suit, which had already been in progress for several years, and which is famous among such litigations under the title of the Horsford vs. Hecker case.

Here again President Morton's thorough experimental work and diligence in research developed remarkable results, which were sometimes almost dramatic. Thus, at a hearing on motion for injunction, the counsel for the other side appeared with about a dozen affidavits from chemists of wide reputation, all going to show the theoretic impossibility of a reaction which President Morton had cited from various early authorities. These were successfully met and overthrown by a single affidavit and some samples, prepared by President Morton, in and by which he first explained certain conditions, overlooked by the other affiants, which would radically modify the theoretical conclusions, and then showed, by the results of experiments, that the conditions DID exist and DID

modify the reactions as they should, if the theoretical assumptions were corrected by taking these conditions into account.

From this time on, President Morton has occupied the position of the leading scientific expert in New York and its vicinity, and the revenue derived from this class of professional work has enabled him to contribute to the growing needs of the Stevens Institute of Technology, not only by the larger donations which we have elsewhere noticed, but by many others involving less amounts, but large in the aggregate, and of the greatest importance to the successful development of this Institution.

His natural capacity and large experience as a lecturer and instructor have given him a power and clearness in instructing courts and juries, and his courage and coolness before an audience have their normal development in a collectedness and readiness under cross-examination, which are most valuable qualities in a witness of any sort.

The thoroughness with which he masters the subject matter of his cases, as to both literary and experimental data, is also a subject of surprise to those who know of the vast amount of executive and other work which he transacts as President of the Institute, and as lecturer by choice, in the Department of Physics, to certain classes.

One of the most prominent stenographers employed in the New York courts once said to the present writer:

"We have less trouble in taking down President Morton's testimony than with that of any other witness; he always says what he means, and sees his way ahead so far that if there are ambiguities or forms of expression likely to lead to confusion in the questions put to him by the lawyers on either side, he always straightens them out in the first instance, and so avoids endless confusions and the waste of time that often arises from a lack of clear statement. He loses no time in making his answers, and thus, without hurry, gets through a vast amount of work in a day."

His printed testimony in these cases, if collected in a separate form, would equal in volume a set of Scott's novels, and much of it is very interesting reading to any one conversant with the subjects involved, and occasionally, as a specimen of witty dialogue, has proved entertaining to a general reader. It is often like a Socratic dialogue, only that the answerer, rather than the questioner, generally proves his point. It is full of passages which are models of clear, concise and expressive diction.

SCIENTIFIC RESEARCHES.

During the early years of the Institute, when the classes were small and executive business was light, President Morton devoted his available time to a series of original researches, which developed results of considerable scientific interest.

The results of these researches were published in several scientific journals in this country, and were reprinted or translated and republished in many foreign journals: the principal of these being the "London, Edinburgh and Dublin Philosophical Magazine," the London "Chemical News," the "Moniteur Scientifique," of Paris, and the "Annalen der Physik und Chemie," of Leipsic.

We will give a brief abstract of the subject matter of some of these.

The most extensive and important of these researches was that on the "FLUORESCENT AND ABSORPTION SPECTRA OF THE URANIUM SALTS."*

The property of Fluorescence was first systematically studied by Professor Stokes, of Cambridge, England, and was

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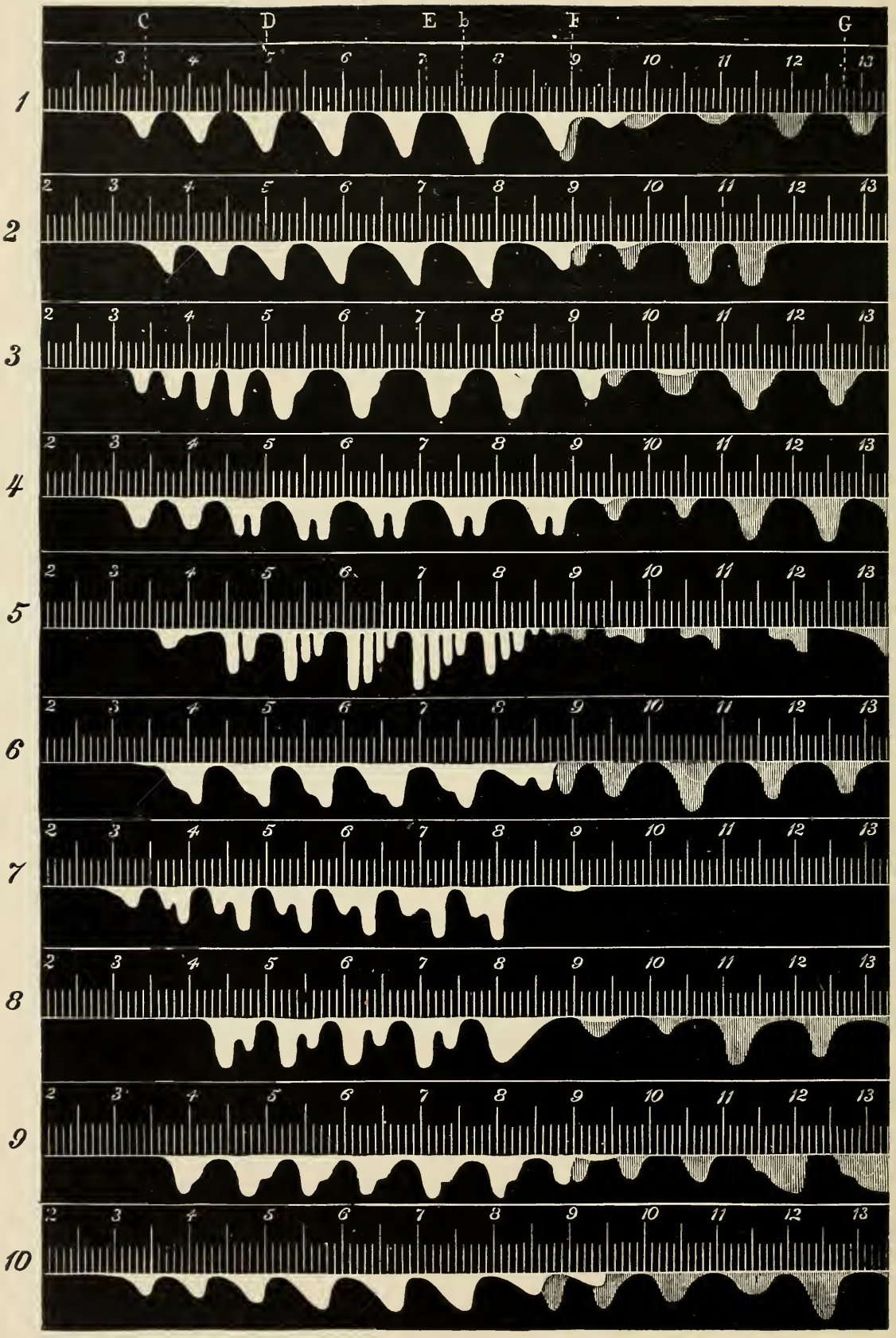
* "Chemical News," London, 1873, Vol. 28, pp. 47, 113, 169, 233, 244, 257, 268; Vol. 29, p. 17.

"Moniteur Scientifique," Paris, Vol. 16, pp. 24 to 34 and 305 to 318, and 318 to 320.

"American Chemist," N. Y., Vol. 3, pp. 361 and 401, 1873; Vol 4, pp. 1, 41, 81 and 125, 1874.



Fluorescent Spectra of the Uranium Salts.

shown by him to consist in a power, possessed by some substances, of absorbing light rays of shorter wave length, and then emitting the same energy in the form of light rays of greater wave length.

Thus a fluorescent substance placed in the path of the blue or violet rays constituting the upper portion of a "solar spectrum" will shine, not with blue or violet light, but with light of a green, yellow, orange or red color, as the case may be.

The effects which may be produced by this means are marvelously beautiful. Thus a vase or goblet of "canary glass" (a substance fluorescing strongly) if held in a beam of violet light, will glow like a self-luminous vase or goblet of emerald.

Nearly all the salts of the element Uranium possess this property in a remarkable degree, and what is more, the fluorescent light which they emit consists of certain definite wave lengths, so that when seen through the spectroscope, it breaks up into banded spectra, equally characteristic and beautiful.

The woodcut on the opposite page will give some idea of these spectra, if it is understood that the white spaces below the scales indicate the location of the bands of light in the several spectra, and show their relative brightness by their vertical dimensions.

The color of these various bands may be fixed by remembering that the part of the scales from 3 to 4 indicates the red part of the spectrum, above 4 orange, changing to yellow at 5, blending into green at or about 7, blue about 9, and violet above 11.

The Uranium Salts whose spectra are shown in this woodcut are: 1, Nitrate; 2, Acetate; 3, Sodio-acetate; 4, Oxychlorides (acid); 5, Potassio-oxychloride; 6, Oxyfluoride; 7, Bario-oxyfluoride; 8, Phosphate (mixed hydrates); 9, Calcio-phosphate; 10, Ammonio-sulphate.

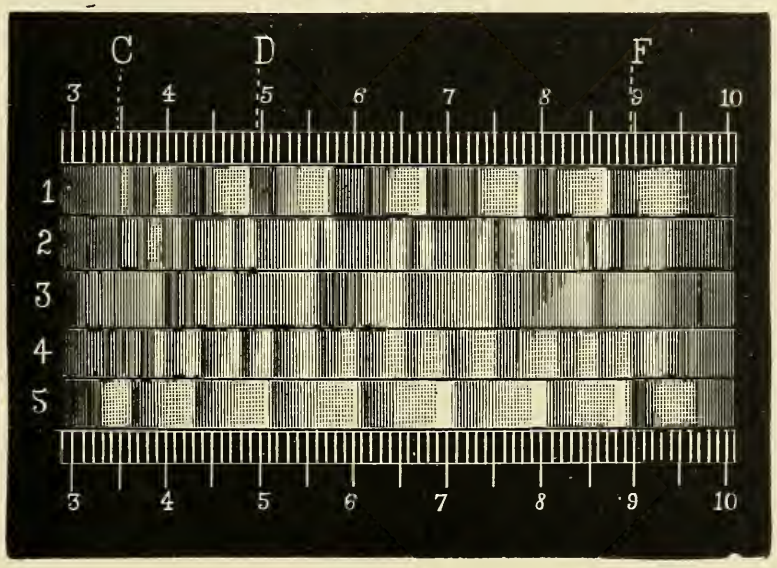
The fluorescent spectra of a few of the Uranium Salts had been examined and recorded by Professor Stokes and by Edward Becquerell, but President Morton prepared and examined over 80 of them, many of which he made for the first time, and by the extent of the work in this regard, was able to arrive at some interesting generalizations.

Thus, for example, there are a great many double-salts in which there is a combination of one acid with two bases, one of which is Uranium, and the other some other element such as sodium, potassium, calcium, etc.

When this occurs it is found that the entire series of salts shows spectra alike in the character and arrangement of their bands, except that, in the various spectra, all the bands

are more or less displaced up or down in the spectrum in relation to each other.

If now a list is made of such a set of double-salts, in the order of the position of their bands, beginning with the substance whose bands are highest in the spectrum, it will be found that this list is also in the order of the molecular weights of the salts, the lightest coming first and so on.



Ammonio-uranic Sulphate.

This result is very interesting when we consider that the Uranium part of the molecule is the source of the action, and that the other element is simply a load to be carried by the former, and, therefore, likely to lower its rates of vibration, just as weights attached to a series of tuning forks will lower their notes.

Again it was found that changes in composition and the formation of new compounds, could be watched and recognized by the observation of these spectra, where otherwise it would be impossible to do so.

For example, if we examine the Ammonio-uranic sulphate, crystallized and dried at atmospheric temperature, we shall find its fluorescent spectrum to be such as is represented in 1 of the figure on the preceding page, which represents, in black and white, the appearance of certain fluorescent spectra as seen through the spectroscope.

On heating this salt so as to expel some water, its spectrum changes into that shown at 2 of the same figure, which will be easily recognized as a combination of the spectrum shown at 1 with a new spectrum or set of bright bands. Further heating and driving off of water caused the bands of the new spectrum to grow stronger and those of the first spectrum to fade, until a point was reached in which the new set of bands appeared alone, as is shown in 3 of the figure. When the salt so treated was then analyzed, it was found to contain no water at all, but to be an anhydrous ammonio-uranic sulphate.

On now pushing the heat to a yet higher temperature, white fumes are given off, and another compound spectrum (4) results, which likewise gradually changes under continu-

ance of the treatment, until the spectrum becomes again simple, as in 5. On analyzing the salt when in this state, it was found to be a diuranic ammonio sulphate, which will bear heating to 650° F. without further change. It is improbable that the existence of either of these salts would have been suspected, had they not been announced by the changes of spectra.

In addition to their fluorescent spectra, these salts of Uranium show characteristic absorption bands in the upper part of the spectrum.

Some of these are indicated in Plate XV by shaded spaces at the right side of the plate.

A study of these also developed many interesting results.

Thus it confirmed the observations as to influence in molecular weight in locating the bands of various double salts, already shown in the study of the fluorescent spectra.

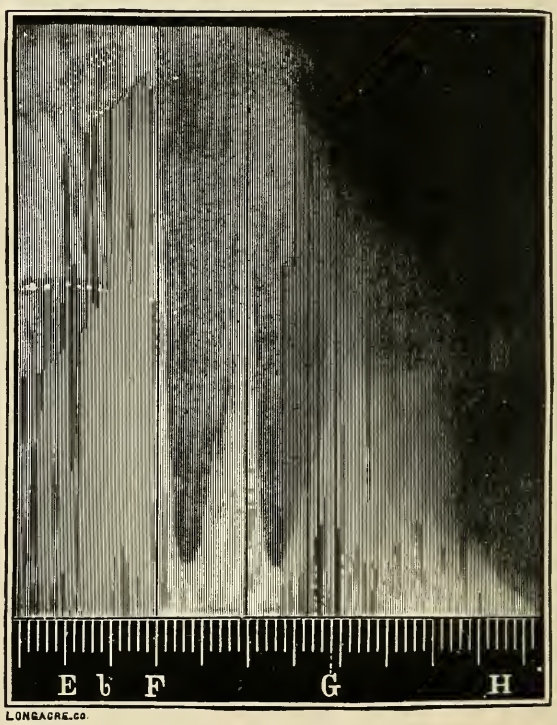
Again it showed that double-salts did not exist, as such, in solution, but only combined in the act of crystallizing.

Numerous other points of interest were developed in this research which, however, we cannot attempt here to even enumerate without exceeding our prescribed limits.

These were followed in the years 1872 and 1873 by another series of investigations which was published in a

number of papers whose combined titles would be expressed as RESEARCHES ON THE FLUORESCENT RELATIONS OF ANTHRACENE, PYRENE, CHRYSENE AND A NEW SOLID HYDRO-CARBON (TO WHICH THE NAME THALLENE WAS GIVEN) FOUND IN CERTAIN PETROLEUM DISTILLATES.*

These bodies were studied by the same general means pursued with the Uranium salts and also by others first suggested by Professor Stokes, such as the projection of a solar spectrum on the side of a tank filled with a solution of the substance to be examined. The side of the tank is made from a plate of "quartz," as this substance, unlike glass, does not absorb the "extra-violet" rays.

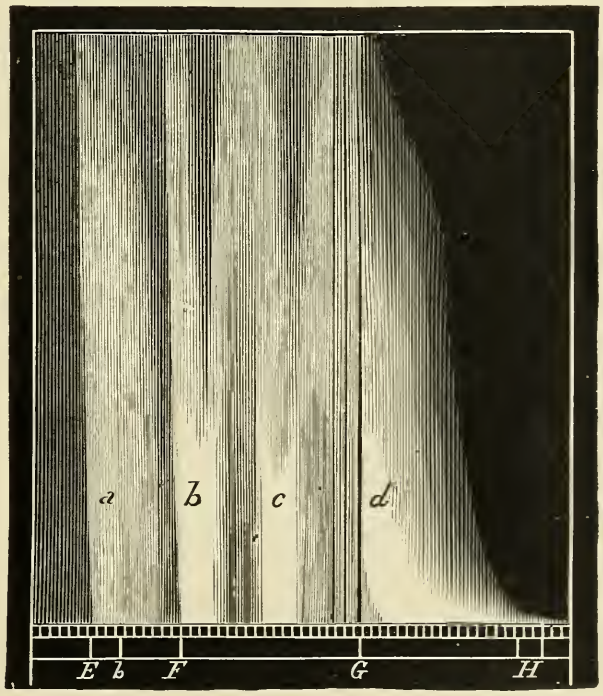


Chrysene in Benzole.

* "Chemical News," Vol. 26, pp. 199, 272; 1872,
"Chemical News," Vol. 34, p. 188; 1876.
"Moniteur Scientifique," Vol. 15, pp. 353 to 356 and 356 to 361; 1873.
"Poggendorff's Annalen der Physik und Chemie," Vol. 148, p. 292; 1872.
"Poggendorff's Annalen der Physik und Chemie," Vol. 155, p. 579; 1874.
"London and Edinburgh Philosophical Magazine," Vol. 46, p. 89; 1873.
"American Chemist," Vol. 3, pp. 81 and 162; 1873.

When, for example, this experiment is made with a tank containing a solution of Chrysene in Benzole the appearance is as shown in the woodcut on opposite page.

The light of the spectrum is here arrested and turned into a brilliant green fluorescence at certain parts, while at others it penetrates in long trails far into the solution, thus showing that certain particular wave lengths or rates of vibration in the light are capable of transformation by this substance into light-waves of different length or frequency, while others are not.

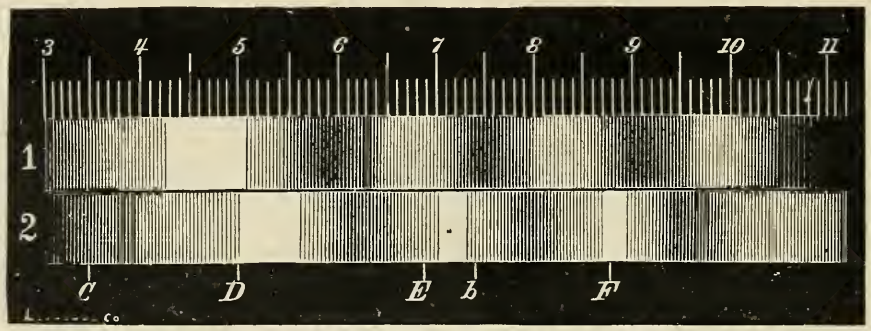


Thallene in Benzole.

Thallene acts in the same way, except that in the case of its solutions these effects are more sharply defined, as shown in the accompanying cut.

This is due to the specially definite character of the fluorescent bands of the substances alluded to by Professor Stokes in his letter to President Morton, printed further on, and is likewise exhibited as a co-related action or result,

when the fluorescent light coming from Thallene in its solid form or in solution is examined with the spectroscope, when four bright bands are manifest, as shown in the accompanying cut, in the upper band or spectrum marked 1.



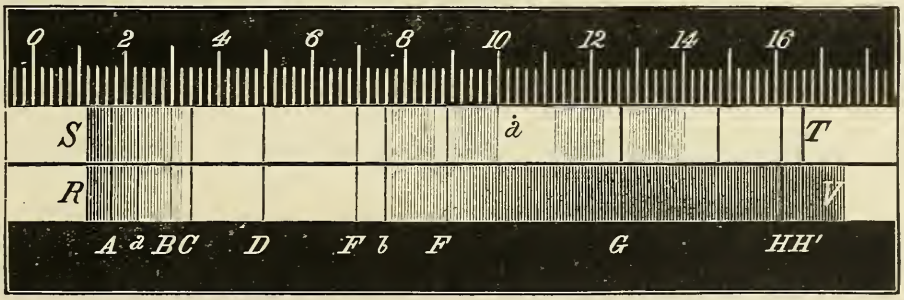
Fluorescent Spectrum of Thallene (1) and of Petrolucene (2).

When Thallene, in concentrated hot solution, is exposed to strong sunlight, as in the focus of a lens 15 to 18 inches in diameter, for from 10 to 20 minutes, its condition is modified so that it yields a brilliant BLUE light by fluorescence, and gives the spectrum shown at 2 of the woodcut above.

The name Petrolucene has been given to this modification.

When a screen covered with a thin layer or paint of Thallene is used to receive a solar spectrum, the blue and violet portions which, on a screen of paper, appear but faintly illuminated, are seen to glow with vivid green light on which the Fraunhofer lines stand out with great distinctness; and the

same is true with a spectrum produced by electric light This effect is made strikingly manifest if a screen is used half of whose width only, for its entire length, is covered with Thallene. Then we have the appearance shown in the accompanying cut, S T being the part of the screen coated with Thallene, and R V the ordinary white surface.



Among all these substances, Thallene possessed the property of Fluorescence (described in connection with the last mentioned research) in a pre-eminent degree. In fact, there is, perhaps, no body then or now known which equals or approaches it in this regard. In this connection an incident of an amusing character may be recorded.

This substance was discovered and extracted, in some quantity, by President Morton shortly before the arrival in this country of Professor John Tyndall, of the Royal Institution, in 1872, when he delivered his memorable course of "Lectures on Light" in our principal cities.

He visited the Institute during his first stay in New York, and President Morton (knowing that the subject of

Fluorescence was touched upon in one of his lectures), presented him with a large design painted with the new substance, suggesting that he should try it, for his own satisfaction, on some occasion when he was rehearsing similar experiments.

Soon after this, President Morton delivered a lecture on Fluorescence at the Academy of Music in Philadelphia, and on that occasion used paintings (made with Thallene and one of its modifications) large enough to fill even that vast stage. These designs, representing flowers, wreaths of laurel and the like, when illuminated by ordinary gas light, are hardly or not at all visible, being attached to a ground of yellow muslin, matching their own tint; when, however, they are illuminated with violet light (such, for example, as is obtained by passing the light of the electric arc through cobalt glass), the background seems like black velvet, on which the designs shine out with a blaze of grass-green and sky-blue color, that is positively startling. These things were shown with full effect at President Morton's lecture.

Now, it happened that Professor Tyndall never thought about trying the design in Thallene, which President Morton had given him, until when, in the midst of one of his lectures in Philadelphia, he came to the illustration of Fluorescence, with such means as he had brought with him.

Some accident of association then brought this design to his mind, and, with the off-hand informality and ease of manner which was one of the many charms of his address, he said to his assistant, but equally for the benefit of his audience :

"By the way, Mr. Cotterill, we have, somewhere, a fluorescent design which President Morton gave us—some new substance he has discovered. If it is at hand, hold it up in the beam of violet light, and we will see how it looks."

Mr. Cotterill promptly found the design and held it up in the violet light, when it blazed out with its peculiar brilliancy and so startled the lecturer that he exclaimed :

"Good Heavens ! I never saw anything like that in my life ! "

The effect of this exclamation upon the audience, most of whom knew President Morton personally and had attended his lecture a week or so before, can be better imagined than described.

The value given to these researches by the highest authority on this subject—namely, Professor Stokes of Cambridge, who was the first to investigate and to name this phenomenon, is indicated by the accompanying letter, and one useful application, at least, of the new body Thallene is shown in the letter from Professor Holden of the Astronomical Observatory, Washington, D. C.

OBSERVATORY ARMRYH, IRELAND, JULY 24, 1873.

DEAR SIR: I fear you must have thought me ungrateful for delaying so long to thank you for your very interesting present of Thallene and Petrolucene and the apparatus for showing easily their powerful fluorescence. It reached me at a time when I was busily engaged with a daily lecture besides other business, so that I had not time then to do more than try the experiment with your apparatus, and also by examination in ordinary daylight strained by transmission through suitable absorbing media, such as a deep blue glass [by Cobalt], a deep violet glass [by Manganese], etc. This last is a very easy and, at the same time, effective mode of examination.

The most interesting feature of the fluorescent light consisted in the circumstance that, on being examined by the prism, its spectrum exhibited, in the case of both substances, several maxima of intensity. I could have told from this alone that the spectrum of the transmitted light would present bands of absorption, as you have mentioned that it does [Phil. Mag., xliv., 345]. With the exception of certain salts of sesqui-oxide of uranium, the fluorescent light of which exhibit bands much more definite than I have seen in the case of any other substance, Thallene and Petrolucene show this phenomenon the best or among the best.

I delayed writing until I should have leisure to examine the substances by sunlight, by means of what I have called a linear spectrum [Philosophical Transactions for 1852]. This I have now done; and naturally the maxima of intensity of the fluorescent light are shown even more distinctly.

Should I find measurement of the positions of these maxima likely to lead to interesting results, I will write to you again to avail myself of your kind offer to let me have small quantities of the substance for dissolving. I am unwilling to spoil the drawing of the flower by cutting off portions to dissolve-out the two substances.

I have not yet been able to see your paper in the "Chemical News," as the numbers were gone to the binder when I went to get it. Yours respectfully,

To [Signed] G. G. STOKES.

PROFESSOR H. MORTON.

U. S. NAVAL OBSERVATORY, Nov. 3d, 1874.

TO PROFESSOR HENRY MORTON, Hoboken, N. J.:

MY DEAR SIR: I have been waiting until our experiment of lighting the verniers of our declination circle should have been thoroughly tried before letting you know of its success.

I think I can say now that the question is solved in two of the three important points: First, we can get a sufficiently

strong current where we wish to use it; second, the Geissler tubes which you kindly furnished us, *with the addition of the Thallene* (and not without), give us light and to spare. The only remaining difficulty is one I had not anticipated. I find that my tubes, which are *fixed* to the telescope, and, therefore, it would seem, insulated from any shocks, are liable to be jarred so as even to break them. One has already been broken in this way. Of course, this is a difficulty of a merely mechanical kind, and can easily be surmounted.

So that finally we have to thank you for your most admirable application of fluorescence in making our original scheme possible.

When you come to Washington this winter, I hope you will come to the Observatory in order that you may see the tubes in operation.

With kind regard,

Very sincerely yours,

[Signed] EDWARD S. HOLDEN.

At the time of his lectures at the Academy of Music, in Philadelphia (between 1865 and 1871), and for many years after, President Morton gave much attention to the develop-

ment of the Magic Lantern as a means of illustration. During his secretaryship at the Franklin Institute, a large lantern always stood in position in the meeting-room, so arranged that diagrams and pictures could be thrown on the screen at a moment's notice, and this was constantly used during the meetings of the Institute; in many cases taking the place of a blackboard, as it was not necessary to darken the room, owing to the power of the apparatus.

During this period President Morton made many improvements in the structure and arrangements of the lantern, and devised a large number of adjuncts or appliances by which it could be adapted to the exhibition of new phenomena. Indeed, for three years he conducted the entire business of manufacturing lanterns and other apparatus of this sort, which was originally carried on by Messrs. Hawkins & Wale, and was not in their hands successful, until he had placed it on a good footing, when he transferred it to Mr. Samuel Hawkridge, who has carried it on ever since.

The various improvements and devices above referred to are described in a series of articles published in various journals, as follows:

Method of Producing an Artificial Rainbow on the Stage, "Journal of the Franklin Institute," 1865, Vol. 49, p. 138.

THE MAGIC LANTERN AS A MEANS OF DEMONSTRATION OR LECTURE ILLUSTRATION. A series of articles in the "Journal of the Franklin Institute" in 1867.

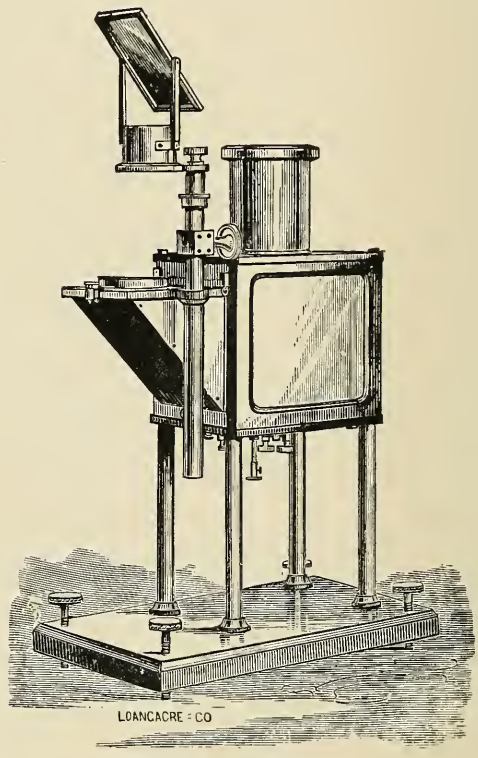
Vol. 53, pp. 55, 204, 282, 354, 406, 409.

Vol. 54, pp. 130, 206, 278, 339.

Vol. 55, 1868, pp. 62, 206, 277, 345, 420.

Vol. 59, 1870, p. 358.

Vol. 61, 1871, p. 300.



The College Lantern.

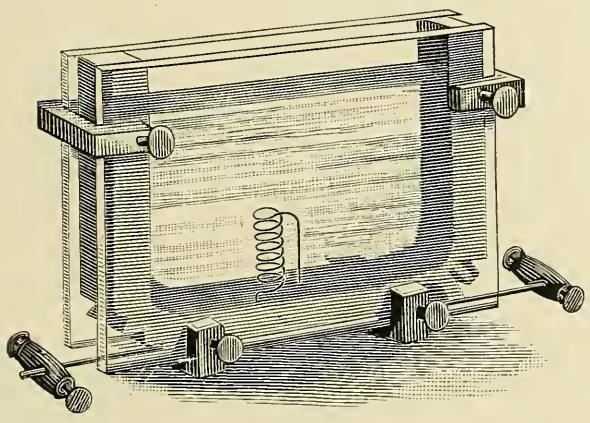
Another series of articles on the same subject was published in the "Scientific American," as follows: 1873, Vol. 29, pp. 163, 184, 200; also in 1876, Vol. 35, p. 328, ON THE GAS MICROSCOPE; also in 1875, Vol. 33, p. 344, ON A CHROMATROPE FOR THE LANTERN; also in 1877, Vol. 36, p. 341, ON THE PROJECTION OF COLORS OF SOAP BUBBLE FILMS ON THE SCREEN.

An article on the same general subject was also published in the "London Quarterly Journal of Science," under the heading: THE VERTICAL LANTERN, in Vol. 1, p. 396, 1872. There was also an article in the same Journal, entitled, LECTURE ILLUSTRATIONS OF SOLAR PHENOMENA, Vol. 3, p. 547, 1873.

Two of these illustrations are also described in a lecture reported in the "Scientific American," for May 3, 1873, Vol. 28, p. 275, and are specially worthy of note.

The first is to illustrate the formation of the clouds of incandescent gas (chiefly hydrogen) which are from time to time projected into the solar atmosphere, and which constitute the "solar flames" or "solar prominences."

It is arranged as follows: A glass tank is formed by taking two pieces of plate glass and clamping them on opposite sides of a strip of thick sheet-rubber bent into a U form, as shown in the accompanying cut. Before this is done, however, a coil of platinum wire is set in the strip of rubber—its ends being connected with thick copper wires terminating with binding screws as indicated.



Then all being put together, we have such an arrangement as is shown in the cut.

To use this, the little tank is nearly filled with water, and then a red solution, made by steeping some cochineal insects in water, is carefully introduced with a pipette so as to make a layer at the bottom of the tank just covering the platinum coil.

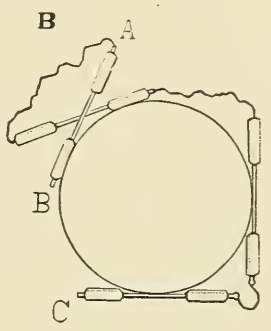
The whole apparatus being then placed in the lantern, an image is thrown on the screen, of a red layer, representing the solar chromosphere, and a clear colorless area representing the solar atmosphere. Then, when the "solar flame" is to be produced, the circuit of a small battery is sent through the platinum coil. This heats it and causes an uprush of the red solution in a cloud-like jet, exactly resembling in shape and movement many of the "solar flames."

By breaking and renewing the current in the coil, a great variety in the forms and movements of the crimson jets can be produced, and as these are all projected, of a vast size, on the screen, the effect is very impressive.

The other illustration was on a smaller scale, as no means of optical enlargement were used, but showed the solar flames of their actual color, and indeed produced them by employing the very same material as existed in those seen around the sun.

In this case, a large picture of a total solar eclipse was painted on a sheet of canvas-backed paper, as roughly indicated in the accompanying cut, the solar flames being represented by holes cut through the canvas paper.

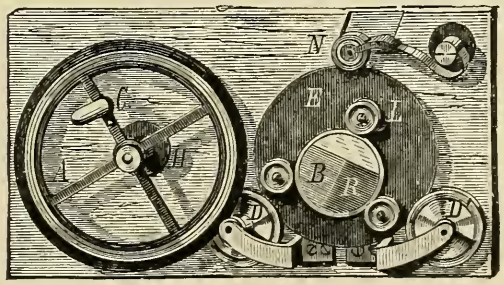
Close behind this perforated picture is placed a white surface to which are attached a number of "spectrum tubes" containing hydrogen, connected by wires, as shown in the accompanying cut, so as to bring them behind the openings in the picture.



When the discharge from the induction coil is passed through these tubes, the brilliant crimson light seen in the solar prominences, which consist, likewise, of incandescent hydrogen, is produced, and, shining through the apertures of the picture, gives a very beautiful and true reproduction of the appearance of a total solar eclipse.

Also, in the *Scientific American*, articles under the headings, LUMINOUS FOUNTAIN, Vol. 21, p. 231, and ERECTING INVERTED IMAGE ON THE SCREEN, Vol. 21, p. 241.

Again, in the *London Chemical News*, under the titles, THE VERTICAL LANTERN, Vol. 24, p. 92, and ACTION OF LENSES, Vol 25, p. 251, and also under the title, EIN NEUES CHROMATROP. *Poggendorf's Annalen,* Vol. 157, p. 150.*



*The chromatrope for the lantern, shown in the accompanying cut, with the various disks to be used with it, fully demonstrates the doctrine of color developed by Young and Helmholtz.

When, in 1878, President Morton became a member of the Light House Board, as we have noticed at a previous page of this essay, he was made Chairman of the Committee on Scientific Tests, and in addition to preparing a number of Reports for the information of the Board only, he also made numerous experiments, and prepared in connection therewith Reports which were published in the Annual Reports of the U. S. Light House Department and elsewhere. Among these the more important were the investigations of the principal forms of dynamo-electric machines and electric lamps. *

In 1879 appeared a paper entitled "NOTES ON THE CHRONOLOGY OF THE ISOMERIC PURPURINES AND THE ACTUAL RELATIONS OF THE BODIES WHICH HAVE BEEN CALLED ANTHRAPURPURIN, ISOPURPURIN AND FLAVOPURPURIN." †

This paper makes very brief reference to a research which occupied more than a year and would have given its author the credit of discovering the body called Flavopurpurin,

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* "Annual Report of the U. S. Light House Board for 1879," pp. 88 to 136.

"Annual Report of the U. S. Light House Board for 1880," pp. 90 to 102.

"Van Nostrand's Engineering Journal," Vol. 22, pp. 397 to 419, and pp. 441 to 450.

† "Chemical News," Vol. 39, p, 255.

"Moniteur Scientifique," Vol. 21, p, 872.

"Journal of the Am. Chemical Society," Vol. 1, p. 186.

which he was the first to isolate and recognize, but that he was led by a liberal interpretation of Auerbach's description of the material which he called Isopurpurin, to give him the credit of discovering the new body until too late to claim it.

This research, however, cleared up an almost hopeless confusion which had arisen in reference to the names above given, in consequence of the fact that each investigator had worked on the material which he was treating in his own way, without making himself familiar with the processes and products of the other workers. President Morton, by thoroughly acquainting himself, by practical operation, with ALL the methods and results, was able to show that Anthrapurpurin and Flavopurpurin were distinct individual substances, while the Isopurpurin of Auerbach was only a mixture of the others.

In connection with the above subject, the following letter from W. H. Perkin, F. R. S., the discoverer of Anthrapurpurin, and also of the first Aniline dye, will be of interest:

THE CHESTNUTS, SUDBURG, HARROW, Sept. 2d, 1879.

DEAR SIR: I have to thank you for your letter of July 26, and should have answered it sooner, but have been much engaged lately.

I was not aware that Auerbach's Isopurpurin was such an indefinite product as you find it to be. I quite thought that

as Auerbach had been so much engaged with the manufacture of artificial Alizarin, he would have had a good knowledge of the coloring matters it contained, so far as they had been examined. He states in his book on Anthracene (translated by Crookes), that Anthrapurpurin, and Isopurpurin are identical. Graebe and Liebermann and others have also called Anthrapurpurin *Isopurpurin;* in fact, the name Anthrapurpurin is not often used on the Continent, as I mentioned in my lectures; and, as I wished to dispose of an idea which has been held by some persons—viz., that Isopurpurin is an isomer of Anthrapurpurin, I stated, on the above grounds, that they were identical. Unfortunately, at the time I was writing my lectures, I was unable to get a copy of the "Moniteur Scientifique" for 1872; otherwise, I should undoubtedly have noticed the statements you kindly draw my attention to.

I have to thank you for bringing forward, in your note published in the "Chemical News," my remarks upon Anthrapurpurin in my paper of 1870. You have undoubtedly seen Auerbach's answer to your note. On this I think I need not comment. As there are some misprints in my lectures as published in the "Journal of the Society of Arts," I have sent you one of my private copies of them. I remain, dear sir,

To Yours truly,

Professor H. Morton. [Signed] W. H. Perkin.

In the same year, 1879, appeared a paper entitled "ON THE ELIMINATION OF ANTIMONY FROM THE HUMAN SYSTEM." *

The research, of which this was the statement, was called out by a medico-legal trial, in which it became manifest that there were no reliable data known at that time as to the subject indicated. This lack President Morton supplied by experiments and results as indicated above.

MEASUREMENTS OF INCANDESCENT ELECTRIC LAMPS.

When, in 1880, the incandescent lamp of T. A. Edison first appeared in an efficient form, President Morton, with some difficulty, secured one of these horse-shoe lamps and made the first thorough investigation which was ever carried out of its electric constants or conditions and efficiency. This was first published in the "Scientific American," April 17, 1880, Vol. 42, p. 241, although it was published or reprinted in a great number of domestic and foreign journals. †

In 1877 President Morton began a series of investigations on products and processes for producing what is popularly

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* "Am. Journal of the Medical Sciences," Vol. 77, p. 89.
"Proceedings Am. Chem. Soc.," Vol. 2, p. 142.
"Moniteur Scientifique," Vol. 21, p. 235.

† "London Chemical News," April 20, Vol. 41, p. 199.
Van Nostrand's "Journal of Engineering," Vol. 28, p. 1.
"London and Edinburgh Philosophical Magazine," 1880. Vol. 10, p. 21.

known as water gas, which were continued, from time to time, during a series of years.* Of these we may mention :

"*Water Gas of Harrisburg.*" "Am. Jr. of Gas Lighting," 1877, Vol. 27, p. 179.

"*Paraffines in Water Gas.*" "Chemical News," London, Vol. 37, p. 187 ; "Moniteur Scientifique," 1878, Vol. 2, pp. 685–8 ; "Am. Jr. of Gas Lighting," 1878, Vol. 28, p. 68.

"*Toxical Effects of Carbonic Oxide in Commercial Water Gas.*" "Am. Jr. of Gas Lighting," 1878, Vol. 28, pp. 90–112 ; "Report of Commrs. of Health," Brooklyn, 1883, p. 172.

"*Water Gas from Coal, its Calorific Energy, &c.*" "Am. Jr. of Gas Lighting," 1880, Vol. 32, p. 99.

"*Some Recent Developments in Artificial Illumination.*" "Am. Jr. of Gas Lighting," 1889, Vol. 50, p. 139.

President Morton has also contributed several articles to encyclopedias, such as those on "*Electricity*" and on "*Fluorescence,*" to "Johnson's American Encyclopedia" ; on the "*Storage of Electricity,*" to "Harper's Monthly Magazine" ; on "*Recent Progress in Applied Science,*" to the "North American Review," and on "*Electricity in Lighting,*" to "Scribner's

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* 1882, Vol. 66, p. 84, N. 391, for December.
1879, Vol. —, p. 526, N. 290, for May.
1889, Vol. 6, p. 176.

Monthly Magazine." This last was afterwards published in book form, with papers on related subjects by other writers, under the title, *"Electricity in Daily Life."*

One of those delegated to collect the matter for these pages, closely intimate with President Morton for many years, can testify, from personal knowledge, as to the wide scope of his studies and versatility of his talent. Many men climb the side of Parnassus by a path leading them directly upwards, so that their field of view is always limited to the one direction towards which their gaze has been turned from the beginning. This symbolizes the growth of the specialist.

The subject of this sketch, on the other hand, has rather marked out a path that tends spirally towards the top, with a constantly widening horizon stretching before him, now north, now south, now east, now west. Such a mind finds interest in all directions—interest in the smallest atom and in the cosmos. The slightest differences, which escape the moderately observant, are detected and their cause analyzed, while startling phenomena when at first presented, are recognized as resulting from well understood causes, and never considered as abnormal.

Walking with Professor Morton up Broadway one autumn afternoon, with the prospect of interviewing the then

notorious, but not yet exposed, Doctor Slade, we stopped to look into the window of the shop of a vender of magical apparatus. We entered, hoping to obtain some notes that might be of use in the coming "seance," and were shown, among other novelties, a new device, consisting of a pendent mirror, upon the polished surface of which the conjurer, standing at a distance, seemed to throw some marked coins, which successively became visible on the glass, one at a time, in a horizontal row, when, clapping his hands, the coins fell into a hat suspended below the glass. After seeing this, which was then a new illusion, as we regained the street, President Morton at once explained its modus operandi correctly to the most minute detail, a striking instance of quick inventive capacity.

The illusion, he said, might be easily accomplished by having in front of the mirror a plain sheet of plate glass, which touched the mirror at the bottom, but was held a little away from it at the top, forming a wedge-shaped space between the two glass surfaces. The coins, he thought, were fastened in the upper part of the frame, and by electric magnets were made to drop one at a time, when they slid between the glasses as far as they could go; then the glasses were opened by a like electro-magnetic action, and the coins dropped into the hat suspended below.

Such minds are seldom led into the error of explaining physical facts by assumed superhuman agency. Knowing, as does the writer, that, in the majority of cases, brilliant scientists are most easily deceived by such exhibitions, this little incident is recalled as a striking instance of the versatility of President Morton's talents.

Wide, too, as has been his research into the physical laws which govern matter, and extended as has been his reading, yet clearly has he kept his mind free from those useless meditations that lead many men of ability, in their ardent seeking after truth, to lose all faith in the teaching of the church. Like Dr. Benjamin Franklin, at no moment has he been led to enter into discussions unsettling his own faith and the faith of others, and narrowing his existence to life in a mundane state only.

On the contrary, he has been able to perceive that, while Science and Religion could no more support or refute each other directly, than could Geometry and Chemistry, there was the exact harmony of general plan and analogy in process and result in the phenomena revealed by True Science and True Religion which we might expect in two such distinct but co-related parts of one great Cosmos of Mind and Matter.

These views he has very clearly expressed in an article entitled "The True Relations of Physical Science to

Religion," contained in the "Stevens Indicator," 1888, Vol. 5, p. 158.

The taste for drawing which led President Morton, in his college days, to illuminate the Rosetta Stone Report, continued to prove useful to him in his subsequent work.

Thus he made numerous colored drawings of a large size to illustrate his class lectures at the Episcopal Academy and at the University of Pennsylvania, and constantly made small drawings for use in the magic lantern in connection with his "Secretary's Report on Novelties in Mechanical and General Science" at the monthly meetings of the Franklin Institute. While editor of the "Institute Journal," he also made his pencil useful, and drew on stone a number of the illustrations which appeared from time to time in that publication.

He also prepared many lantern illustrations for his Academy of Music Lectures, either by drawing them on glass plates or making pictures on paper which were afterwards reproduced, as transparencies for the lantern, by photography.

In this connection occurred an amusing incident, which we will here record.

When Professor Richard Proctor, the author of so many popular books on astronomy, came to this country on his first lecturing tour, he found himself very inadequately sup-

plied with illustrations, in view of the auditoriums in which he was to appear, having only brought with him a number of charts about three feet square. President Morton, with his usual and hereditary hospitality, no sooner heard of this than he placed his extensive collection of illustrations and apparatus at the Professor's command, and even went, with his assistants and apparatus, on various occasions, and superintended the arrangement of all the experiments.

It happened that Professor Proctor's lecture on the Moon was first delivered in the Brooklyn Academy of Music, and President Morton, being unable to attend, sent his assistants to see to the illustrations, and, with them, a letter to Professor Proctor, describing some of the pictures which were among those to be used.

In this letter President Morton, in reference to certain imaginary views of locations on the Moon, said, "Numbers 3, 4 and 5 are from paintings by Mr. James Hamilton, a distinguished marine painter, of Philadelphia, but No. 6 (alluding to one of his own designs), as you will easily perceive, is by a very inferior artist."

The next evening Professor Proctor repeated the same lecture in New York, and President Morton, with a number of his family and friends, occupied advanced seats among the audience.

When it came to the exhibition of the pictures, Professor Proctor, with his national velocity in apprehending an American joke, quoted literally from President Morton's letter, and, to the intense amusement of the latter and his friends, said, "The last three pictures are from paintings by Mr. James Hamilton, of Philadelphia, but that which I now show you (as 6 sailed in upon the screen) is, as you will easily perceive, by a very inferior artist." It may be imagined that President Morton's party found some difficulty in maintaining that gravity of deportment which their location demanded.

Professor Proctor heard of the joke some time afterwards, and in one of his lectures, delivered during a subsequent visit to New York, he related it to a highly appreciative audience, as appears from the report of this lecture in the "New York Tribune," Extra No. 15, p. 6, April 9, 1874, where he kindly says at the conclusion of the story, "We shall have the picture brought on the screen. I think there is much in it indicating great artistic skill, and not only so, but there is a clear recognition, on Professor Morton's part, of the way in which the craters must have appeared."

Besides these useful applications of the pencil or brush, President Morton has found time to apply this artistic capacity to lighter uses in the illustration or illumination of various

From a Colored Design Painted by President Morton in 1866.

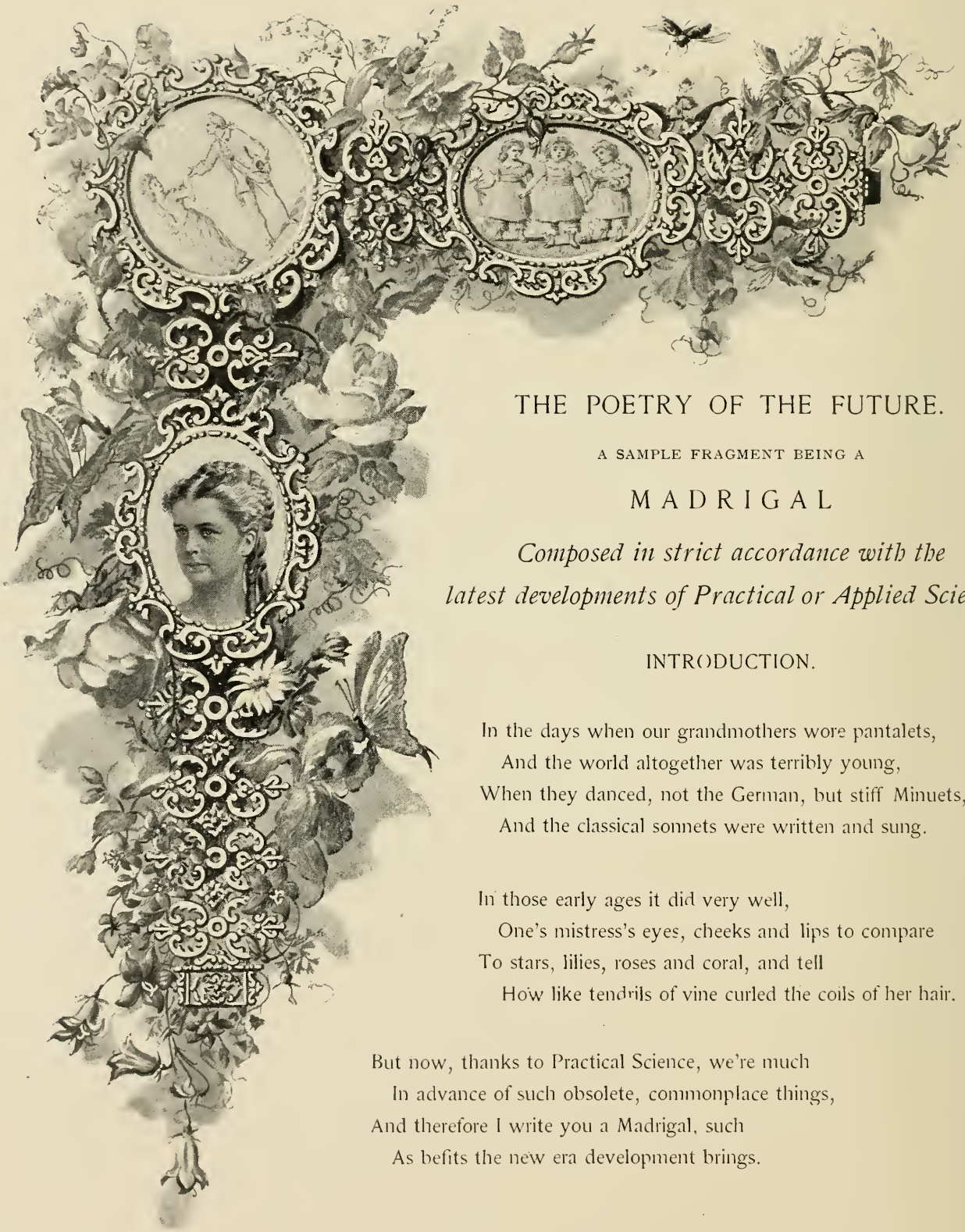
poetical productions, which he has, from time to time, produced for the amusement or pleasure of his family or friends.

We here give a reproduction, in black and white, of a brilliantly colored title page to an humorous poem entitled "The Damson Tart or True-Love," which he wrote and illuminated throughout as a gift to a very dear friend. The style and substance of this literary effort may be inferred from its last verse or "Moral," which reads as follows :

Ye fair ones who peruse this tale,
Take well this lesson to your hearts;
Th' accomplishments of most avail
Are culinary arts.

In this connection it should be said that a notice of President Morton's work and character would be incomplete, which made no mention of a poetic and humorous vein which showed itself constantly in his written and spoken words, and, in a more condensed and concrete form, in his definitely poetical compositions, which, with few exceptions, have been unknown outside of the immediate circle of his intimate friends.

We will here introduce a few short pieces as examples of what we consider to be the characteristics of his style.



THE POETRY OF THE FUTURE.

A SAMPLE FRAGMENT BEING A

MADRIGAL

Composed in strict accordance with the latest developments of Practical or Applied Science.

INTRODUCTION.

In the days when our grandmothers wore pantalets,
And the world altogether was terribly young,
When they danced, not the German, but stiff Minuets,
And the classical sonnets were written and sung.

In those early ages it did very well,
One's mistress's eyes, cheeks and lips to compare
To stars, lilies, roses and coral, and tell
How like tendrils of vine curled the coils of her hair.

But now, thanks to Practical Science, we're much
In advance of such obsolete, commonplace things,
And therefore I write you a Madrigal, such
As befits the new era development brings.

THE MADRIGAL.

The warmth of the affection that my fair one does inspire
Is two thousand Centigrade degrees, I'm sure, or even higher;
Such clear white hot devotion doth consume me night and day
As would melt a furnace lining of the best Mount Savage clay.
The force of sweet attraction that does emanate from her
Can't be measured by the largest sort of dynamometer;
And its limitless extension in directions manifold
Is like the gravitation, which does suns and planets hold.
Her hair the gloss and color has of bi-sulphide of tin,
And the rosy hue which dyes her cheeks might be alizarin
With alumina for mordant, which, through clay, suggests again
Her pearly teeth diaphanous, like Berlin porcelain.
To express her lips' ripe redness coral will by no means do,
For in shade they fully equal Roussin's orange number two;
With her blue eyes' depth of color no flower that grows can cope,
But they're like the lines of Cæsium, seen in the spectroscope.
To express her general sweetness no fit emblem we'd compose,
Though to sucrose we add dextrose lævulose and meletose;
And, indeed, to give it measure we must much extend the scale
Of the standard Saccharometer known as the Duboscq Soleil.
Her intellectual brightness in extent surpasses quite
A forty thousand candle-power Brush electric light;
While, in mild and steady radiance, it casts a shade upon
The incandescent horse-shoe lamp of T. A. Edison.
But her manifold perfections, did I name them every one,
Would take more lines than there are miles between us and the sun;
So here I'll stop, nor of the rest make any further note, or
I might get uncontrollable, like Mr. Keely's motor.

A Word with Wings.

A WORD WITH WINGS.

To a lady with a slight, and in fact charming, impediment in her speech.

When lovely Lucy talks to me,
I seem to see a door
Through which a crowd of winged Loves
Are issuing by the score.

They tread upon each other's heels,
With jostlings and with trips,
But still they pour in merry throng
Between the coral lips.

Let others tell of that fair maid,
That fairy-gifted girl,
Who broke her speech with diamonds and
At each word dropped a pearl.

But I would give Golconda's mines
And wealth of every sea,
If Lucy would one little word
With wings bestow on me.

A JUNE BIRTHDAY.

JUNE 21, 1862.

This month is the month of the royal rose,
  This queen of months for the queen of flowers;
It brings her the softest breeze that blows,
  With the brightest sun and the freshest showers.

And so the sweet roses stray everywhere,
  O'er hedges they clamber, on trellises creep;
From terrace of lordliest gardens they stare,
  And into the cottager's window peep.

They waylay our path through the woodland glade,
  They carpet our porch with their scattered bloom;
And ev'n where their daring steps are staid,
  They haunt us still with their winged perfume.

But sweet June will go and her roses die,
  And leave us but memories of pleasures past;
Ah, gentle; ah, beautiful June! say why
  Do you bring me no flowers, no joys that last!

But no! pray pardon me, lovely June!
  You have brought to me and Earth a flower,
More bright than the brightest that glows at noon,
  That shall live and shall bloom in Eternity's bower.

Then thanks, thou sweet June! Yes, a thousand times
  I thank thee and bless thy most bountiful hand;
Go! bear other roses to other climes;
  Thou hast left me the flower of all the land.

From a Painting by THOMAS B. CRAIG.

A June Birthday.

TO BETTY

The dinner now is all arranged,
  But e'er we do divert
Our thought to less important things,
  Let's settle on dessert.

It should be something delicate,
  And warm and sweet and nice;
Not indigestible like pies,
  Nor cold like water-ice.

The "Charlotte-Russe" too common is,
  For all her high-toned airs,
So are "meringues," "glacé" or "cream,"
  And "chocolate eclairs."

But ah! "*Brown betty*"*is *the* thing;
  There apples, sugar, spice,
With bread and butter blended are
  In ratios to entice.

Such apples as made Adam fall,
  Sugar as sweet as Eve,
Bread, crumb and crust, and cinnamon
  Could fancy more conceive?

If then I have been good and true,
  And not *at all* a sinner,
Oh! let me for my *great desert*,
  Have "Betty" after dinner.

---

* The name of a pudding made of apples, mixed with bread crumbs, butter, sugar and cinnamon, and baked brown.

A DECEMBER BIRTHDAY.

DECEMBER 11, 1803.

Chill winds are on the wing,
  Cold snow-clouds sail the air,
Groaning the swaying branches swing—
  Sadness sits everywhere.

Yes, short the rule of Day,
  Short and of feeble light;
While Night holds lengthened sway—
  The star-crowned, sky-throned Night.

But Day is of the earth,
  While Night is of the sky;
His light shows all below of worth,
  Hers all that's fair *on high*.

What though the day be short,
  Brief are its labors, too;
While by those few hours' toil is bought
  Sweet rest the whole night through.

Then hail! Though dark and sad,
  Thy omen holds high hope;
Life's brief toil o'er, there's had
  Long rest beneath Heaven's cope.

Work while day's brief hours fly,
  While yet for work is light;
So shalt thou win for aye
  The *heavenly rest* of night.

From a Painting by THOMAS B. CRAIG.

A December Birthday.

TO MISS NEWTON.

"Nature and nature's laws lay hid in night,
God said, let Newton be, and all was light,"
So sang the poet of the sage whose name
You bear, and bearing, emulate his fame ;
For where *you* go, all nature's face is bright
With beauty's radiance and with love's delight.
He did the *laws* of that great force unfold
Which in its grasp does suns and planets hold,
But you *exert* a force more potent far
Than that which guides the perishable star,
For *your* attraction sways with sweet control
The destinies of the immortal soul.
He saw an apple drop and from its fall
Deduced the weight of this terrestrial ball.
But you can claim that apple as *your own*
Which was by Até 'mid the banquet thrown,
Marked "For the fairest" but assigned to one
Who ne'r with you could bear comparison.
Yes, beauty's, so called, Goddess must resign
Her sceptre when her claims are matched with thine
And yield the golden apple though its gain
Cost such a ransom, on the Trojan plain.

A SILVER WEDDING.

AUGUST 20, 1887.

Twenty-five years of halcyon * weather,
O'er rippling waves and beneath skies of blue,
Such has been our long life voyage together,
Such is the life that I owe to you.

Twenty-five years of devotion tender,
Twenty-five years of unlimited love ;
Could more than this be asked to render
A life-time here, like the life above?

Twenty-five years since that hour fateful,
When, with trembling hand but heart so brave,
Into my keeping, longing, grateful,
Freely yourself and your life you gave.

Courage heroic and faith devoted,
Risking its all on a single cast;
Though it was all unseen, un-noted
My heart reveres 'till it beats its last.

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* According to an old Greek fable, there was a bird called the Halcyon which built its nest on the surface of the ocean, having knowledge when there would be a calm lasting long enough for it to hatch its brood. Hence the term "halcyon" for enduring fair and calm weather.

From a Painting by GEO. H. MCCORD.

A Silver Wedding.

As I look back on the years departed,
Shadows I see where there might have been sun,
But, thanks to you, my true love, true-hearted,
Quickly they drifted as cloud shadows run.

Each astronomical text-book teaches
There is a moon which, in twenty-eight days,
Waxes and wanes, and presently reaches
Its dark, or rather invisible, phase.

But I know one that no such rules fetter ;
Twenty-five years it has waxed alone ;
And after that, it now shines better
Than when it first as our " Honey-moon " shone.

May I but hope these years beatific,
Overflowing with pleasure to me,
Have been of joy but half as prolific,
Half as abounding in pleasure to thee.

A GOLDEN WEDDING.

DECEMBER 2, 1890.

Golden light the sun is shedding,
Ushering in this golden wedding,
As he did on that bright day
Fifty golden years away.
Then, as now, the "golden flowers,"
Lingering after Summer's hours,
The Chrysanthemums *, foretold
Anniversary of gold.
Golden love and golden truth
To gold age from golden youth;
In the fire of Life thrice tried,
Pure themselves, yet purified
By the sorrows borne together,
By the stress of stormy weather;
This pure gold, outlasting Earth,
Proves its own celestial birth,
And shall shine with golden light,
Star-like, in Heaven's dome of night.

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* The word "Chrysanthemum" comes directly from the Greek name of this flower, meaning "Golden Flower," from χρυσός, gold or golden, and ἄνθεμον, flower.

From Design by GEO. H. MCCORD.

A Golden Wedding, December 2, 1890.

BURIAL OF THE AMERICAN FLAG

AT MEMPHIS, 1860.

With mocking mimicry of woe,
  With death march swelled by ribald shout,
With each vile insult, and the show
  Of hatred, see the rabble rout
Are bearing to a shameful grave
The flag their fathers died to save.

"Ashes to ashes, dust to dust,"
  Jeering they huddle it from sight
Dishonored, spit upon, they thrust
  The glorious emblem from the light,
Whose folds, blown out by victory's breath,
Once ev'n made fair the gates of death.

Those trait'rous hearts, those villain hands!
  Did they, then, *bury* that fair flag?
There, where the fresh raised hillock stands,
  Did they entomb a lifeless rag?
No! *They but sowed a living grain,*
Which sown, shall bring forth fruit again.

That noble banner cannot die,
  Gemmed with the stars of human hope,
Tinged with the azure of the sky,
  The gleaming blue of Heaven's cope,
Dyed red with blood by heroes given,
Bleached by saints' tears and smiles of Heaven.

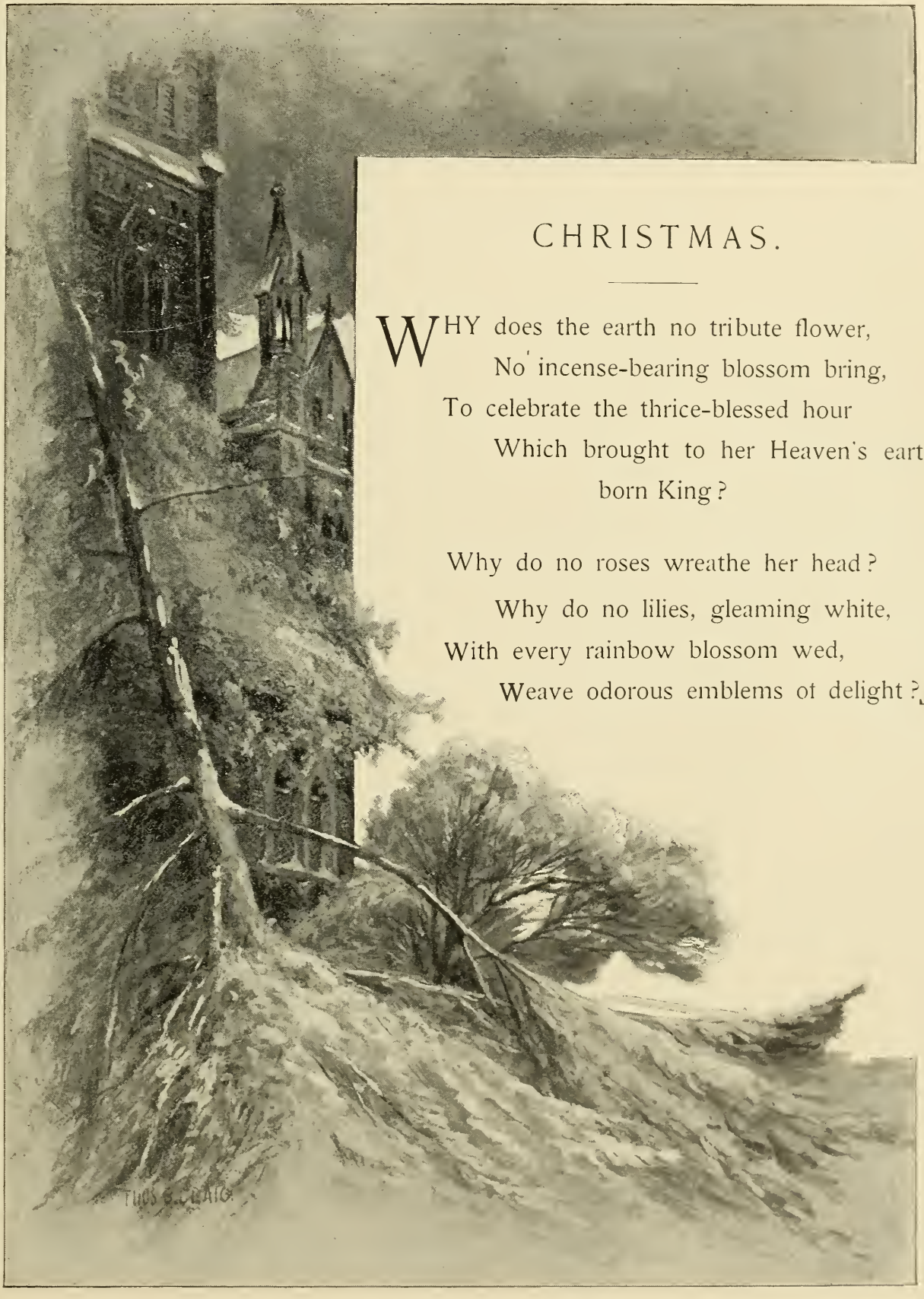
There, where it lies, that living seed
  Shall not in darkness find decay;
Its life a myriad lives shall breed,
  And thrust a fruitful crop to-day;
A *host* of banners there shall bloom,
And float serene o'er *treason's tomb*.

ON THE DEATH OF A DEAR FRIEND.

In the vast caravan which o'er the sand
Of time, creeps onward toward the promised land
Of human hope and happiness for each,
Which yet how few of all that host may reach.
Out-worn, exhausted by the toilsome way
Our brother fell, as 'twere but yesterday;
He fell, to rise no more beneath the sky,
But passed into the perfect life on high.
Ah, gentle soul, so loving, kind and true,
What blessedness was there in store for you.
Hath *he* not said, who his own life hath given
And died in agony to win us Heaven,
"Blessed and welcome to Eternal rest
Are those through whom their fellow-men are blessed;
Who 've soothed with kindly hand another's grief
And found delight in ministering relief."
That "Even a cup of water given in love
Might win perennial streams 'mid meadows
fair, above."
What hand so prompt as his for other's aid?
What heart so kind has ready hand obeyed?
No thought of self found harbor in that breast
Always unbarred to welcome the distressed.
The kindliest soul that e'er to man was given,
With him departing, sought its native heaven.
The blessings that commingled with our tears
Amid Heaven's harmonies he surely hears;

And the fond love his goodness won him here
Will find its way to him even in that highest sphere.
For hath it not been said by him we trust
Supremely: of the good, the true, the just,
That: "From their labors when at last they rest
Their works do follow them, and they are blessed."
We mourn with bitter tears and heartfelt woe
The loss *we* suffer missing him below.
But for our grief is surely balm in this,
He enters earlier into endless bliss:
There by the shining river's shade-cool shore
He waits to welcome, having gone before.

From Design by GEO. H. MCCORD.

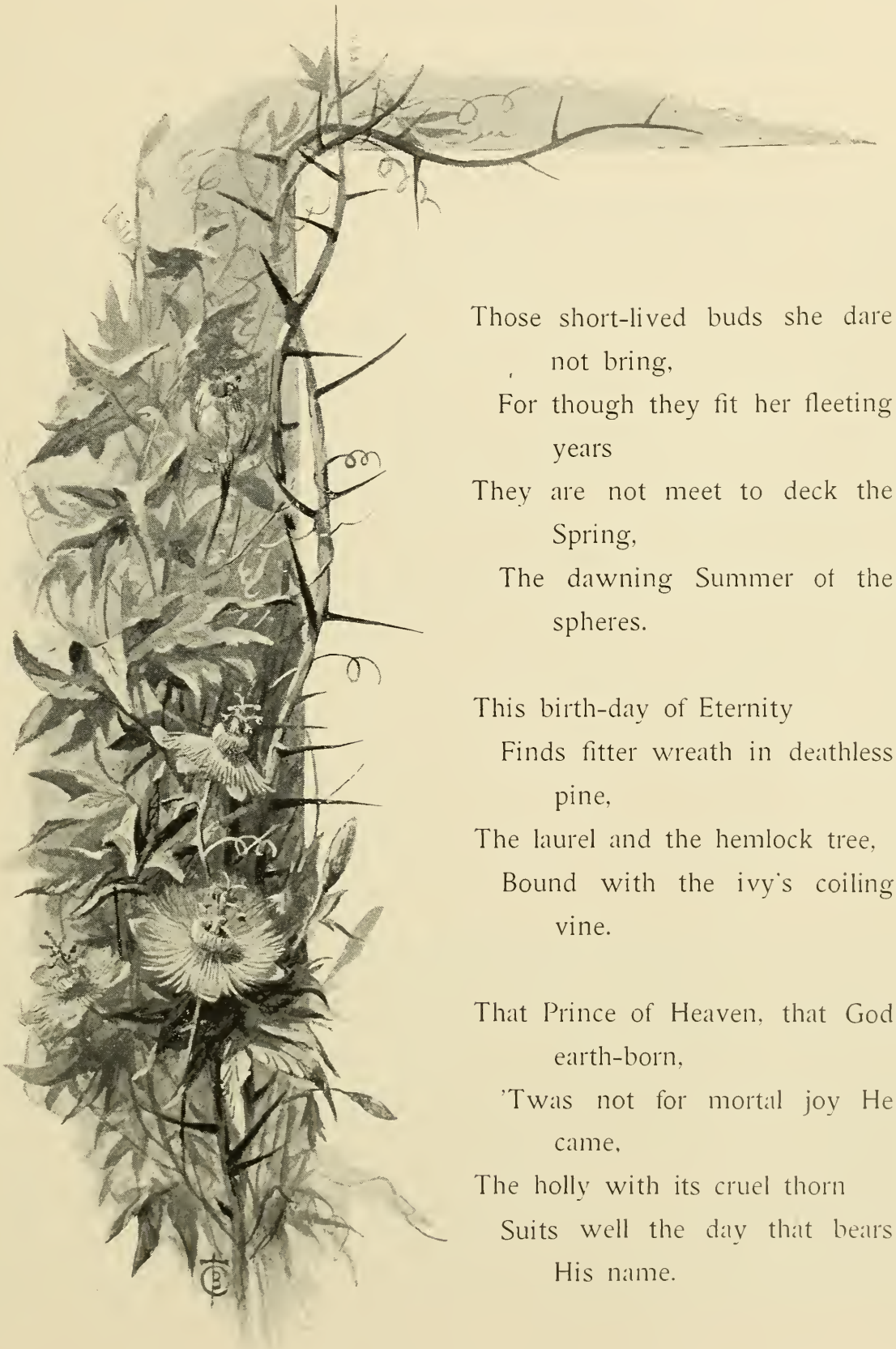


CHRISTMAS.

WHY does the earth no tribute flower,
No incense-bearing blossom bring,
To celebrate the thrice-blessed hour
Which brought to her Heaven's earth-born King?

Why do no roses wreathe her head?
Why do no lilies, gleaming white,
With every rainbow blossom wed,
Weave odorous emblems of delight?

Text re-printed from the December number of the Century Magazine, 1890.



Those short-lived buds she dare
not bring,
For though they fit her fleeting
years
They are not meet to deck the
Spring,
The dawning Summer of the
spheres.

This birth-day of Eternity
Finds fitter wreath in deathless
pine,
The laurel and the hemlock tree,
Bound with the ivy's coiling
vine.

That Prince of Heaven, that God
earth-born,
'Twas not for mortal joy He
came,
The holly with its cruel thorn
Suits well the day that bears
His name.

Prophetic of the thorn which crowned,
(Fit token of its victory),
That love unparalleled, profound,
Compassionate 'mid agony.

And the white wrappings of the snow,
Like swathings in the manger's gloom,
And drifts that under thick boughs show
Like grave-clothes in the empty tomb.

May 10th 1902

DEATH OF HENRY MORTON

The Distinguished Career of the Head of Stevens Institute.

He Gave to the Institution More Than $145,000 for Various Purposes— His Work as a Scientist.

President Henry Morton of the Stevens Institute of Technology, and a scientist of world wide reputation, died at 10 o'clock last evening in the private hospital, 33 East Thirty-third Street, where he had undergone an operation three weeks ago. He was the son of the Rev. Henry Jackson Morton, for half a century rector of St. James's Protestant Episcopal Church in Philadelphia, and was born in this city, Dec. 1, 1836.

He was graduated from the University of Pennsylvania in 1857, taking a post graduate course in chemistry, and was studying law, when offered the position of instructor in chemistry and physics at the Protestant Episcopal Academy in Philadelphia, which he accepted, and devoted the rest of his life to scientific attainment. He published a translation of the text of the Rosetta Stone in 1859, and in 1863 was the head of an expedition formed to observe and make photographic records of a total eclipse of the sun in Iowa.

In the same year he became Professor of Chemistry at the University of Pennsylvania, and in 1870 became the first President of Stevens Institute, which was then being formed in accordance with the will of Edwin A. Stevens. He selected the Faculty, and during his tenure of office, which continued without interruption to the time of his death, he gave the institution more than $145,000 for various purposes.

He was for eight years a member of the United States Lighthouse Board and had been a member of the National Academy of Sciences since 1873. He married Miss Clara Whiting Dodge of this city in 1863. Mrs. Morton died less than a year ago at their country home at Pine Hill, N. Y. Two sons survive them.